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HERBERTIA

International Journal of the American Plant Life Society, devoted to the increase and diffusion of knowledge on bulbous plants and petaloid monocot families, especially the Amaryllidaceae.

VOLUME 41
1985

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Cover: *Hymenocallis* 'Sulphur Queen'—Reduction of an 18" by 24" etching print by Garry Newton.

IN THIS ISSUE . . .

We have expanded the use of color. The Society now uses a computer (microprocessor) to prepare the type-setting for this and future issues. This cost-saving step will allow a more cost effective publication of *Herbertia*.

This issue has several articles which chronicle the history of *Nerine* and *Alstroemeria* culture in the United States. Cultural techniques on *Hymenocallis*, *Hippeastrum* and *Eurycles* are addressed. Thad Howard's travelogue carries us across the bulb-strewn Mexican landscape. Alan Meerow summarizes the amaryllids of Ecuador. Hybridization in *Hippeastrum* is addressed by our Australian correspondent, Warren Glover, as well as "Dee" Cothran. Mike Rudometkin outlines his commercial production of *Hippeastrum*.

There are no specific plant groups or persons focused upon in this issue. Rather, the broad, international spectrum of bulbous plant interests is reflected in these pages of *Herbertia*, 1985.

R. Mitchel Beauchamp, Editor

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HERBERTIA, Volume 41, 1985

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A SURVEY OF ECUADOREAN AMARYLLIDACEAE

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Ecuador, situated between Colombia to the north and Peru to the south, while hardly as bountiful a storehouse of Amaryllidaceae as its neighbor to the south, is nonetheless blessed with a fair share of interesting species. This small Andean nation is, in fact, the center of distribution for the genera *Eucrosia* Ker-Gawler and *Phaedranassa* Herbert, the latter being a conspicuous feature of roadside vegetation at middle to upper elevations. *Eucharis* Planchon is prevalent in the understory of Amazonian Ecuador's lowland rainforests, and can be sparingly found as well in the wet premontane forests of the northwestern cordillera. My monographic work on *Eucharis* and a treatment of the family for the Flora of Ecuador has allowed me an intimate acquaintance with Ecuadorean amaryllids, not a few of which are attractive plants in their own right.

Harling (1979) describes 16 vegetation zones for Ecuador, which reflects the ever-increasing seasonality and aridity of the Pacific lowlands as one moves south, coupled with the rain-shadow effects of the complex Andean chain. The vegetation of southwestern-most Ecuador is, in fact, indistinct from that of contiguous northwest Peru and, not surprisingly, several erstwhile Ecuadorean species have crossed political boundaries.

Phaedranassa and *Eucrosia* are the pre-eminent genera of Ecuadorean Amaryllidaceae. Together with the Peruvian genus *Rauhia* Traub, these genera form a natural group conceivably from a common ancestor. Their closest affinity is with the large, and mostly Peruvian genus *Stenomesson* Herb. *Phaedranassa*, *Eucrosia* and *Rauhia* all exhibit reduction trends in androecial connation, and possess distinctly petiolate leaves with expanded lamina. The somatic chromosome number for all three genera is $2n = 46$, the most common number occurring in *Stenomesson*. Seeds of all three genera are flat, brown or black, and obliquely alate. These morphological earmarks are all represented at times within *Stenomesson*, which, for the most part, however, exhibits a distinct staminal cup and linear-lorate leaves.

Phaedranassa is possibly the only neotropical genus of the Amaryllidaceae that has actually benefited from man's disturbance, having colonized roadcuts throughout Andean Ecuador with great alacrity. Both it and *Eucrosia* are found predominantly in seasonally dry formations of western Ecuador, though at least one species of each is also found in montane rainforest.

For the systematist, *Phaedranassa* presents particular problems, as an examination of the genus from only a few specimens presents a rather blurry picture of species distinction. Ravenna's (1969) synopsis was a beginning, but a thorough collection of living material, field observations and sizeable loans from the world's major herbaria reveal the need for further clarification.

A taxon, for the moment best called *Phaedranassa cinerea* Ravenna (Figure 1), and *P. dubia* (H.B.K.) Herb. (Figure 2) are probably the most common species. *Phaedranassa cinerea* has long been in cultivation, often as *P. carmioli* Baker, a Costa Rican species of uncertain identity, or *P. chloracra* Herb., a name assigned by Ravenna (1969) to synonymy with *P. dubia*. *Phaedranassa cinerea* and *P. dubia* are, however, easily distinguished. *Phaedranassa cinerea* is found exclusively at middle elevations and is rarely, if ever, collected above 1900 meters. The olive-green leaves are frequently densely glaucous on both sides and appear after the flowers, as with most species in the genus. The flowers, 8-12 in number, range in shape from tubular to slightly ventricose. I have observed and sampled four populations of this species and have found it remarkably uniform within narrowly variable limits of perianth size and shape.

Phaedranassa dubia, on the other hand, is strictly a high elevation species. The adaxial surface of the leaf is a bright green color; the abaxial surface is only slightly glaucous. Flowers are fewer, rarely more than six to the umbel. Almost all species of *Phaedranassa* have similar perianth morphology. The short corolla tube may be green or concolorous with the tepals, which are coral-pink or salmon for much of their length. In most species the apical region of the perianth is also green, with yellow or white hyaline margins. Two species, *P. schizantha* Baker and *P. lehmannii* Regel, apparently lack the green pigmentation at the tepal apices. It quickly becomes obvious that many of the morphological features used to distinguish taxa in this genus are superficial and probably subject to considerable variation. At present, I am assessing the range within populations of variation in such characters as perianth size, coloration and exertion of the stamens, and am hopeful that a more realistic perception of the genus will emerge. In some cases, it appears that micromorphological foliage characters may provide greater insight into species delimitation than will floral characters. These difficulties are of course hardly ameliorated by the apparent absence of type specimens for many of these (and other amaryllid) species.

Lower elevation *Phaedranassa* species were probably restricted to locally-dry, open cliffsides and steep riverbanks within middle-montane forests in pre-Colombian times, while upper elevation species flourished in



Figure 1. *Phaedranassa cinerea*, large-flowered form. Alan Meerow photo.

Figure 2. *Phaedranassa dubia*. Alan Meerow photo

Figure 3. *Phaedranassa* sp., possibly *P. schizantha*. Alan Meerow photo.

drier grassy paramos and scrub formations of the Inter-Andean valleys. The bulbs often cling tenaciously to rocky outcrops, lodged in pockets of humus and soil. Certain roadsides in Ecuador now teem with large populations. A case in point is the taxon named by Ravenna (1969) as *P. tunguraguae*. In 1969, when it was described, Ravenna characterized the plant as extremely rare. It is now quite locally abundant at the type locality (near Banos, Ecuador).

In cultivation, *Phaedranassa* are accommodating subjects. Most, if not all, of the species flower in Ecuador during the latter half of the summer dry season (July and August). I have successfully enforced dormancy by withholding water at various times of the year, with subsequent flowering following 1-2 months after the leaves die down. *Phaedranassa cinerea* can be induced to flower twice per annum if a substantial (several month long) period of vigorous leaf growth is allowed between dry treatments. This species also sets copious amounts of seed in the greenhouse, ostensibly via self-pollination, though I have not yet investigated the possibility of apomixis in this species.

Phaedranassa extends into neighboring Colombia and Peru, and a single obscure species, *P. carmioli*, was described from Costa Rica. A species I collected in Colombia in 1984 may, in fact, be conspecific with *P. carmioli*. An unusual species collected just outside of Ambato, Ecuador last summer, with orange-salmon and yellow flowers (Figure 3) may be the equally obscure *P. schizantha*. Ravenna (1969) considers this species synonymous with *P. lehmannii*, a Colombian species with long-exserted stamens that are shortly connate at their base. Material that I have since received from the Traub Herbarium (now housed at the Missouri Botanical Gardens), collected by Mulford Foster (unfortunately without locality) bears exacting resemblance to the illustration that accompanies Regel's (1883) description of *P. lehmannii*. I suspect that it is a unique taxon unto itself. I currently await the type specimen of *P. schizantha*, which hopefully will resolve this all-too-familiar taxonomic conundrum.

Eucrosia species are notable (with a single exception) for their long-exserted, declinate stamens which may be as much as three times the length of the perianth. Another unique feature of the genus is the presence of nectar glands at the base of the staminal filaments in all but one species. The vegetation zones of western Ecuador, variously subject to seasonal patterns of precipitation, have been an important factor in the evolution of this completely low and middle elevation genus, and species distributions reflect this mosaic with great fidelity.

Eucrosia bicolor Ker-Gawler (Figure 4) is still relatively common in the western lowlands from Guayaquil north to Quevedo, and sparingly west

toward the Pacific coast. It is a denizen of low elevation semi-deciduous forest and savannah, an area that has now largely given way to sugar cane, oil palms and, where seasonal inundation occurs, to rice cultivation. The leaves of this species are mesophytic, reflecting abundant moisture availability during their short season of growth, and appear soon after the flowers open. The zygomorphic flowers are orange-red in color, the short tube green at the base. The long, yellow-cream staminal filaments protrude from between the lower two limb segments shortly before anthesis, and continue to lengthen during the subsequent day. Anther dehiscence generally occurs the following day. The bulbs are vigorously stoloniferous and soon form large clumps. Unlike most *Eucrosia*, the stamens of *E. bicolor* are connate basally into a staminal cup, cleft irregularly between the filaments. Related to *E. bicolor* but occupying drier sites is *E. brachyandra* Meerow and Deghan. As its epithet suggests, the brevitous stamens of this species set it apart from the rest of the genus. Like *E. bicolor*, however, it possesses a staminal cup of similar morphology. This is the plant variously known as *Stricklandia eucrosioides* (Baker) Baker, *Leperiza eucrosioides* Baker and *Phaedranassa eucrosioides* (Baker) Benth. and Hook. Its small flowers are red.

Two species of *Eucrosia* are found respectively in coastal deserts and southern dry scrub vegetation and in the lower Inter-Andean semi-desert zones. *E. aurantiaca* (Baker) Pax (Figures 5-6) and *Eucrosia eucrosioides* (Herb.) Pax (Figure 7) are almost indistinguishable in foliage. The leaves are large and considerably more succulent than those of *E. bicolor*, and the bulbs can become fairly massive in diameter. Of the two, *E. aurantiaca* is the more attractive, and the most variable in flower color. The nicest forms are a rich, lemon-yellow color (Figure 5), the flowers borne in umbels of 10-18. The long filaments are green. A pink morph can occur within an otherwise yellow-flowered population, and one such was mistakenly named by Traub (1957, 1966) as *E. eucrosioides* var. *rauhiana* (Figure 6). Similar color dimorphism is found in *Stenomesson variegatum* (R. & P.) Macbr. (cf. *S. luteoviride* Baker) and in *Phaedranassa* (cf. *P. viridiflora* Baker, superfluously renamed by Ravenna (1984) as *P. viridilutea*). An additional synonym for this species is *E. morleyana* Rose. The flowers are emerald green before anthesis. In one of my collections from the semi-desert scrub of Azuay province, the flowers at maturity retain a green apical zone. The flowers of *E. eucrosioides* (Figure 7) possess a smaller perianth and are colored green and orange-scarlet. The adaxial surface of the leaves of this species are curiously pitted, a feature which Herbert (1845) noted in his description of the plant as *Callipsyche eucrosioides*. Ravenna (1984) recently described a plant from Peru, *E. peruviana*, as allied to this species. Examination of pollen and several specimens reveal *E. peruviana* to be a

Stenomesson, one very close to *S. miniatum* (Herb.) Ravenna. Both *E. aurantiaca* and *E. eucrosioides* require a sustained period of dormancy, and leaves do not appear until long after the scape has withered. The bulbs are extremely slow to offset.

The newest species of *Eucrosia*, *E. dodsonii* Meerow and Dehgan, breaks sharply with the xeric ecology of all other species. The plant grows in the understory of lower montane rainforest on the western declivity of the Andes. It is the northernmost-occurring species in the genus. Its yellow flowers are the largest of the Ecuadorean taxa (*E. mirabilis* Baker, a Peruvian taxon of seemingly mythical dimensions, now lost to cultivation and never recollected, bears this distinction overall), and lack the characteristic nectar glands. The absence of these structures may implicate their presence in other species as a means of reducing nectar loss by evaporation.

Stenomesson, ostensibly a precursor of both *Phaedranassa* and *Eucrosia*, is not absent from Ecuador but is nowhere plentiful. One species, *S. aurantiacum* (H.B.K.) Herb. (Figure 8), with campanulate, orange flowers and linear leaves, is ubiquitous at elevations approaching and exceeding 3000 meters throughout the length of the Andean Cordillera. It extends north into southern Colombia and south into Peru. The stunning *Stenomesson variegatum* (Figure 9), (that which Ravenna (1978) calls *S. splendens* (Herb.) Ravenna), and its color morph, *S. luteoviride*, were collected in Ecuador in the first half of this century, but their presence has not since been recorded.

The related genus *Pamianthe* is represented in Ecuador only by the diminutive *P. parviflora* Meerow, known only from the type collection. In August 1984 I searched the type locality in vain for this interesting species.

Few *Hymenocallis* have been reported in Ecuador. *Hymenocallis* (Elisena) *longipetala* (Lindl.) Macbr., apparently once frequent in dry, southern Ecuador, has not been of late recollected. But in the dry, sparse, rolling hillsides surrounding Guayaquil, *H. quitoensis* Herb. (Figure 10) still prospers, and I find few species of this wide-ranging genus as attractive and botanically interesting as this one. One hillside overlooking the city, as recently as three years ago, boasted an enormous population of this plant. The sight of hundreds of these huge, solitary ephemeral flowers in mass was an unforgettable panorama, similar, I imagine, to the synchronized blooming of *H. amancaes* (Ker-Gawl.) Nichols. around Lima, Peru. The site has since been bulldozed and developed for housing. Baker (1867) described a single high elevation collection of this species as *Ismene andreaana*.

Eucharis, by and large, is most prominently a feature of Amazonian rainforest. As one traverses the dense, lowland forests of the Napo and Pastaza valleys, the Amazon lilies are soon encountered. The *Eucharis* of





Figure 8. *Stenomesson aurantiacum*. Alan Meerow photo.

Figure 9. *Stenomesson variegatum*. APLS photo.

Figure 11. *Eucharis astrophiala*. Alan Meerow photo.

eastern Ecuador have presented me with some of the most taxing systematic problems I have encountered in my work. Various morphs present a mosaic distribution about the region. This may be the result of human vectors, as the bulbs have long been featured in the folk pharmacopocia of Amerind tribes of Amazonas. One of the most interesting discoveries of my recent botanical forays into Ecuador was that of diploid ($2n = 44$) forms of *Eucharis amazonica* Linden ex Planchon (the *E. grandiflora* of horticulture). Peruvian representatives of this species have a somatic chromosome number of $2n = 68$, and are partially sterile. It is apparently these populations from which our cultivated clones have been drawn. Collections of *E. amazonica* from both sides of the Ecuadorean Andes have 44 chromosomes, are fully fertile, and differ from the Peruvian genets in a few minor morphological characters. The Peruvian *E. amazonica* may therefore represent a triploid-derived isolate of the species.

Figure 4. *Eucrosia bicolor*. Alan Meerow photo

Figure 5. *Eucrosia aurantiaca*. Alan Meerow photo

Figure 6. *Eucrosia aurantiaca*, pink form. This is the plant mistakenly described by Traub as a variety of *E. eucrosioides*. Alan Meerow photo.

Figure 7. *Eucrosia eucrosioides*. Alan Meerow photo



Figure 10. *Hymenocallis quitoensis*. Alan Meerow photo.

In addition to *E. amazonica*, only a single additional species of *Eucharis* subg. *Eucharis* is found in the pre- and lower-montane forest of northwestern Ecuador. *Eucharis astrophiala* (Ravenna) Meerow (Figure 11) is an attractive, dwarf species with uniquely ovate-lanceolate, bullate leaves. The flowers are small and the staminal cup distinctively edentate.

A few other amaryllids occur within the borders of Ecuador. *Crinum kunthianum* Roem. can form extensive populations along the swampy, tidal estuaries about the Gulf of Guayaquil. *Hippeastrum puniceum* (Lamarck) Voss has sporadically been collected, perhaps as an escape from cultivation. It is not altogether unlikely that a few amaryllid novelties yet await discovery within the country. I maintain high hopes that a careful study of such genera as *Eucrosia* and *Phaedranassa* will provide further insight into the patterns of plant evolution. It is in this, above and beyond the realm of alpha taxonomy, where the ultimate goal of any true systematic endeavor should lie.

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AN UNUSUAL HEMEROCALLIS CLONE

HERBERT KELLY, JR.
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In 1982 I was given a collection of *Hemerocallis* clones by Dr. Hamilton P. Traub. These were his own creations, many with potential as breeders. Because of limited space in our automobile, only those plants exhibiting exceptional traits were collected. All plants were unnamed and none had been introduced to the trade. Dr. Traub stated that because of numerous undertakings, he was unable to fully evaluate these plants and wished me to do so. He said they were colchicine-induced tetraploids and many were exceptionally beautiful. Note: readers may refer to past issues of *Herbertia* and *Plant Life* for a wealth of information and research data on *Hemerocallis*, compiled by Dr. Traub.

One of these *Hemerocallis* clones has exhibited many unusual characteristics. It has produced flowers with eight tepal segments, instead of the usual six. This strange phenomenon occurs about 80% of the time. It is well known that some *Hemerocallis* clones with the usual six tepal segments, will produce an occasional flower with eight segments. However, to my knowledge, none have been reported that produce eight segments with such regularity.

Another interesting characteristic is the enormous size the flowers have attained. On June 1, 1984 a flower was measured at 25.4cm (dinner plate size) in diameter. The bloom period begins in the latter part of May or early June and continues through December. Ten to fifteen blossoms are borne upon sturdy scapes reaching 45.7cm to 61cm in height. There are four small tepal segments measuring 1.9cm to 2.54cm in diameter and four large segments to 5.08cm in diameter. Tepal segments have reached from 10.2cm to 12.7cm in length. The flower is striking and resembles a gigantic sunburst (Figure 1). Its color is a beautiful golden yellow. Temperatures reached 113°F in full sun and low humidity with flowers holding up exceptionally well. There was little color loss and a minimal amount of sunburn. Pollen is fertile. The plant sets an occasional seed, proliferates at a moderate rate and appears to be semi-evergreen.

Incidentally, when this plant produces flowers with the usual six tepal segments, its blossoms are equally beautiful. Flowers have reached from 12.7cm to 17.8cm in diameter. The three small tepal segments measure 2.54cm to 2.86cm in diameter with three large segments 3.9cm to 5.08cm in diameter. Tepal segments have reached 6.4cm to 8.9cm in length (Figure 2).



Figure 1. Traub *Hemerocallis* showing double corolla complement. Herbert Kelly, Jr. photo

Figure 2. Traub *Hemerocallis* with flower showing 6 tepal segments. Herbert Kelly, Jr. photo.



On December 15, 1984 another unusual factor surfaced. The plant was still flowering with individual blossoms lasting from five to seven days. Was this a result of the cooler temperatures at this time of year?

In an attempt to answer many questions about this clone, I consulted with Mr. Bob Brooks, owner of Cordon Bleu Farms in San Marcos, California. Bob specializes in *Hemerocallis*, and was impressed with this plant's unusual characteristics. He noted the fact that the plant's huge flower size, eight tepal segments (80% of the time) instead of the usual six, and the almost unheard of fact that a *Hemerocallis* flower has lasted more than a day or two, makes this plant a candidate for further evaluation. New findings will be reported in future issues of *Herbertia*.

THE HISTORY OF **ALSTROEMERIA** PRODUCTION IN NORTH AMERICA

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The purpose of this article is dual; (1) to have in the literature a rendition of the early *Alstroemeria* history and (2) to solicit comments and information from others in the United States and Canada. In retrospect, it is amazing how, in less than a decade, this genus has become an important economic crop with little or no promotional efforts by any organization.

A colleague, Dr. R. E. Widmer from the University of Minnesota, first told me about *Alstroemeria* after his European visit in 1974. I first saw the beauty of the genus from his slides. In 1975, while in Europe, I visited Mr. R. A. Goemans, Sr. of Parigo Horticulture Co. in England and other workers in the Netherlands. During this visit I became interested in the *Alstroemeria* and learned all I could about its culture and physiology.

It is my understanding that Mr. Goemans is the father of modern *Alstroemeria* production because of his very early interest and breeding efforts. In the Netherlands I also saw this genus under research at the Aalsmeer Experiment Station and at the van Staavern Company where it was under production and saw their early breeding developments. There were also a few *Alstroemeria* flowers in 1976 being marketed in Europe.

Subsequent to this, Mr. van Staavern was persuaded to send us a few rhizomes for research. At that time, 'Regina' was the leading cultivar. 'Regina' is still available and has bright pink flowers. 'Regina' is very vigorous but extremely intolerant of high temperatures. Consequently, it is cyclic in flower production, with a peak in May and June. True, 'Regina' has been replaced by other cultivars, but I still feel it was or is one of the highest producers. The flower color, to my mind, was a "perfect" clear pink.

In the spring of 1975 we were told that if we found the control mechanism for flower initiation and development of 'Regina', we could, no doubt, control flowering of the other cultivars and hybrids in the future. So, we researched 'Regina'.

Our first shipment of plants (rhizomes with one or two shoots and attached storage roots) arrived in August, 1975. They were pathetic, as the rhizomes had to be washed free of soil prior to entering the United States. I recall we had slightly more than a 50% success rate with these plants. We hardly knew "which end was up" and we followed our European

oral cultural instructions as best as I could recall. Interestingly, this June (1984), the van Staavern Company estimates that there are over 150,000 *Alstroemeria* plants in the United States.

Between August, 1975 and the fall of 1976, we increased our alstroemeria plants in sufficient numbers to commence our first experiment at Mr. Don Rosacker's "North Farm" greenhouse range north of the St. Paul campus of the University of Minnesota. At that time, Mr. Royal Heins, now an Associate Professor at Michigan State University, commenced working on one of his Ph.D. thesis topics, "The interaction of temperatures and photoperiod of *Alstroemeria*". This research, published in 1978, eventually won the Kenneth Post Award in 1980 for the best paper published in the Journal of the American Society for Horticultural Science. Heins had arrived at the University of Minnesota in August, 1975 for his Ph.D. work.

Mr. Rosacker played an important role in those experiments. He furnished us with greenhouse space (ground beds) as we had none at the University of Minnesota's research range. He patiently cut and connected pipes and thermostats so we could have heating available for these ground beds. Most importantly, he provided the free labor to pull shade cloth for the short-day treatments. From this work, we noted that flowering was delayed when soil temperatures were heated to 70°F (20°C). Also, we first observed that short-day treatments delayed flowering, while photoperiod lighting hastened flowering when compared to plants in natural daylight conditions. We also had a sunken 50 gallon drum with which we attempted to heat and circulate warm water in the ground beds.

In January 1978, what I called "The first international meeting on *Alstroemeria*" was held in Seattle, Washington, in the old Olympia Hotel. Those who attended were Dr. Molnar from the Saanichton Research Station in Sidney, British Columbia; Mr. Don Duncan, a long time private alstroemeria collector and hobbyist from Sumner, Washington; Royal Heins and myself. When I think back now, how little we knew and what did we talk about all day? The fish dinner was good in the Space Needle Restaurant at the site of the 1962 World's Fair.

The Fred C. Gloeckner Company became distributors for the van Staavern cultivars in the late 1970's. Because of losses in shipping between the Netherlands and North American growers, Mr. Henry Mollgaard of Snohomish, Washington now receives the plants from Europe, pots them and establishes the plants prior to customer distribution in North America. I should also state that the Gloeckner Foundation financially aided us in our early *Alstroemeria* research efforts and it was Ted Sabelis from Gloeckner's who really encouraged this plants' introduction into North America.



Figure 1. *Alstroemeria haemantha*, Univ. Minn. photo.

One of the earliest commercial *Alstroemeria* growers in California was Mr. Erwin Mojonier of Encinitas, California. I recall the interesting conversations we had comparing cultural and technical information. His first rhizomes were planted in 1977 and commenced production in 1978.

Mr. Will Healy became a graduate student in 1977 and commenced working with *Alstroemeria* where Royal Heins left off. Another former graduate student, Mrs. Marcia Celusta, working at a vocational school, became involved and gave us greenhouse space and also the use of her high-intensity discharge (HID) lights in her teaching greenhouse at the Hennepin County Vocational School. We found that HID lights only intensified the response of photoperiodic lighting, the dates that production commenced were similar, but production was increased by the added photosynthetic light.

Healy, now at the University of Maryland, was really the one who cleverly illustrated that rhizome temperature controls flowering. He used a series of water temperature tanks in which the plants (rhizomes) were grown at controlled soil temperatures to find that the rhizomes perceived the low temperature induction and refined the knowledge that at 50° to 55°F. (10° to 13° C.) soil temperature, regardless of air temperature, the



Figure 2. *Alstroemeria* plant division. Univ. Minn. photo.

Figure 3. Vegetative stem of *Alstroemeria* arising from rhizome with attached fibrous and fleshy storage roots. Univ. Minn. photo.



rhizomes produced flowering shoots "forever". AT 70° F. (20° C.) soil temperature, devernalization occurred and flowering eventually ceased, even if rhizomes had been vernalized at 41°, 50°, or 55° F.

Drs. W. C. Lin and Molnar in British Colombia have done much to further clarify the impact of day continuation at evening, night interruption and day continuation prior to sun-up of low or high intensity lighting under the poor light conditions of British Columbia.

Presently, the new cultivars from the Netherlands are becoming more and more tolerant of high temperatures and poor light in the winter. Thus, production is less cyclic and constant. An example is 'Jubilee'.

We are out of the "alstroemeria business" at the University of Minnesota. However, much needs to be done for further understanding. We do not know if "devernalization" occurs at the same speed at 59° F. as at 70° F. Is devernalization accumulative or is it reversible after an unknown number of days at 70° F. and then returned to 55° F.? What is the relationship of the storage roots, carbohydrates, and other stored materials? Why does it take so long to recycle (revernalize or rewind the biological clock) and get the plants in production again? Is some substance or substances inactivated, becomes insoluble or cannot be transported to the new potential flowering stem sites? We have observed time and time again that even at 70° F. soil temperature, 55° F. air temperature and under long-day photoperiod or HID lighting, we do get some flowering. Are these potential treatments to be developed? Also, we do not understand why one cycle of flowering stems will have very long stems and the next cycle will have short stems.



Figure 4. Commercial cut flower production of *Alstroemeria* under glass. Univ. Minn. photo.

AN INTERVIEW WITH ERWIN MOJONNIER, FLORICULTURIST

A major center for U.S. *Alstroemeria* production is coastal southern California. The San Diego County area, especially, has a high volume of cut flower production, including alstroemerias. One of the major growers of alstroemerias in that area is Erwin Mojonnier.

The Mojonnier family has for three generations been involved with of greenhouse horticulture, beginning in Washington state. Mr. Mojonnier currently produces carnations and alstroemerias at his 13 acre range in Encinitas, California, about 20 miles north of San Diego. His *Alstroemeria* production represents a major portion of the U.S. production. The first crop was planted at the Mojonnier range in 1977 and involved all available cultivars.

The first commercial source of plants was the Dutch supplier and hybridizer, van Staavern. Later other suppliers, such as Mr. Cor van Duyn, Konst-Farace, and van Zanten Brothers entered the *Alstroemeria* suppliers market. All the Dutch hybridizers rent or lease their hybrid plants on a contract basis. The grower pays a price per plant or number of square meters utilized. Plants remaining after the rental or lease period must be destroyed and no propagations made from the leased stock. Sports or mutants observed in the leased plants are the property of the supplier. Agents of the hybridizer check on the operation of the leases to insure that everything is in accordance with the contract. Past violations of contracts have resulted in law suits and fines which show how solidly the hybridizers control their products. Plant patents also protect the hybrids, but the one-on-one contracts with cut flower alstroemeria growers insure that the hybrids are not available to non-contract growers.

The mass production of new *Alstroemeria* hybrids is now being achieved by tissue culture. Some older cultivars, however, are still produced by division of stock.

The commercial cultivation of species and older cultivars, such as the Ligtu hybrids, is not profitable because they have short bloom periods and some are not available in commercial stock volumes.

A major source of competition for U.S. grown alstroemerias is Colombia. It has been Mr. Mojonnier's observation that color fastness of the Colombian-grown alstroemerias is less than the cooler grown California material.

Pests of commercially grown alstroemeria hybrids are limited due to the rapid growth of the stems. *Rhizoctonia* vulnerability varies according to clone, some dying out over an 18 month period, yet in the same untreated spot, another clone will grow unaffected. *Phytophthora* and *Pythium* will



Figure 1. Alstroemerias from Erwin Mojonnier Enterprises:
yellow- 'Yellow King'; pink- 'Pink Triumph', 'Jacqueline', 'Ballarde', 'Apple Blossom'; red- 'Red Sunset';
white- 'Mona Lisa'; lavender- 'Jubilee', 'Luciana', 'Ostara', 'Ornata', 'Lilac Glory'.

attack the tuberous rhizomes and water roots and completely "dissolve" a plant, but this is not a common situation. Aphids affect clones differently. Relative to other cut flower material however, alstroemerias are relatively insect free. Imported stock occasionally has virus. Alstroemeria mosaic virus infection of plants is related to temperature and is prevalent in cultivars such as 'Rosario,' 'Pink Panther,' and other cultivars'.

Commercial *Alstroemeria* production involves the cutting of flower buds before opening. European growers cut when buds are tighter than do U.S. growers. There is some bruising of the buds, but this is not noticeable due to the mottling of the open, and extremely long-lasting, flowers. The major marketing factor of alstroemeria is its intense color and durability.

Commercial hybrids are grouped into "orchid", "butterfly", and other flower types. The newest clones result in continuous-blooming cultivars, such as 'Jubilee'. These reflect the hybrid origin of the clones, which is considered confidential information by the hybridizers. Butterfly types tend to have shorter stems and dark, shining foliage. Their umbels have two to three short-peduncled flowers. Certain butterfly types also have a condition



Figure 2. Commercial production of *Alstroemeria* cut flowers at Encinitas, California. Manual labor is supplied mostly by alien workers. APLS photo

of foliage spotting induced by cold weather. Orchid and other types have more flowers per inflorescence, and larger umbels.

Some cultivars are:

- 'Campfire' orange-red - van Staavern;
- 'Canaria' yellow - van Staaveren - orchid type;
- 'Carmen' red-purple - Parigo Hort. Nsys./Wulfinghoff;
- 'Jacqueline' pink - Cor van Duyn;
- 'King Cardinal' red - van Staavern;
- 'Lilac Glory' pink - Cor van Duyn;
- 'Marina' red - Parigo Hort. Nsys./Wulfinghoff;
- 'Mona Lisa' white-yellow - van Staavern - orchid type;
- 'Orchid.' syn. 'Walter Fleming' (*A. aurea* X *A. violacea*) white + yellow - orchid type;
- 'Orange Beauty' orange-red - van Staaveren;
- 'Orange Triumph';
- 'Pink Panther' pink-brownish pink - Cor van Duyn;
- 'Pink Triumph' bright pink - van Staavern;
- 'Red Sunset' red - van Staavern;
- 'Red Surprise' red - van Staavern;
- 'Regina' pink (*A. pelegriana* X *A. aurea* - van Staavern-orchid type);
- 'Rio' intense yellow - A. Konst. - orchid type;
- 'Rosario' pink - Van der Zwet/Inca - butterfly type;
- 'Rosita' cyclamen pink - van Staavern;
- 'Yellow Sun' yellow-orange yellow - A. Konst.;
- 'Zebra' white-yellow - van Staavern - orchid type.

HYBRIDISING CLIVIA

P. GORDON McNEIL

OFCOLACO,

NORTH TRANSVAAL, REPUBLIC OF SOUTH AFRICA

My *Clivia* breeding goes back to 1962 when I bought Gladys I. Blackbeard's collection. Gladys and her sister lived at Scotts Farm, a small place on the outskirts of Grahamstown, East Cape Province, which had been in her family for three generations, but which, in 1962, was included under the "Group Areas Act" into a coloured area.

Gladys had loved *Clivia* since her mother had arranged her plants in a corner of the veranda. She was then a girl.

Gladys would take in sick or wounded animals brought to her by people of all colours to nurse to health. Among her birds was a gayly coloured shrike who would sing all day for a peanut or a grasshopper and fly about the sitting room from its ever-open cage. She also kept huge tortoises and a family of the small geometric ones. Above all, her "Hadada", a variety



Figure 1. Gladys I. Blackbeard and her hadada, "Hadi".



Figure 2. *Clivia* 'German Red' (*C. miniata* X *C. X cyrtanthiflora* selection). G. McNeil photo.



Figure 3. Scotts Farm veranda and *Clivia*. G. McNeil photo.

Figure 4. Putative bi-generic hybrid 'Green Girl' (*Clivia miniata* X *Hippeastrum* sp.). G. McNeil photo.



of ibis, was a very special character who would answer to her call "Hadi" from a hundred feet up and swoop down to perch on her out-stretched arm.

A crippled Stanley crane was jealous and would run at me with flapping wings as I approached his mistress, who had set his broken wing.

I had met Gladys many years before and had often camped on a grassy level behind the house. Once there with me was Gunnar Ising. We did a trip collecting *Cyrtanthus*, described with photos in the Journal of the Royal Horticultural Society, April 1967.

Gladys had written an article published in *Herbertia* (6:191. 1939), in which she mentioned using *Clivia nobilis*, *C. miniata* and its variety, *flava*.

In her collection was that early hybrid, *C. X cyrtanthiflora* and the sweet-scented *X Cliveucharis*, made by van Houtte and published in *Illustration Horticole*, May 1891, as well as in the *Gardeners Chronicle* (IX,3rd:708. 1891). Gladys probably acquired the last of these plants from Europe in exchange for *Clivia* offsets from her plants. I repeated van Houtte's hybrid, i.e. *Clivia miniata X Eucharis grandiflora*. When it flowered in 1979, I found that a lot of my Scotts Farm plants had the same perfume, presumably from its *Eucharis* parent. No wild *Clivia* are scented. Recently I have made the above cross using wild clones of *C. caulescens* and *C. gardenii*. Will it be also scented?



Figure 5. The original cross of *Clivia X cyrtanthiflora*. G. I. Blackbeard photo.



Figure 6. Putative bi-generic hybrid, X *Crineucharis* 'Teresa' (*Crinum asiaticum* X *Eucharis grandiflora*) with shell pink color and strong perfume of *Eucharis*. G. McNeil photo.

Meanwhile, following John Hutchinson's review of the monocots in 1934, wherein he placed *Tulbaghia*, *Agapanthus* and *Allium* into Amaryllidaceae, I have used these three genera in my *Clivia* breeding. I have very healthy plants growing of *C. caulescens* X *Agapanthus*, a very dark, navy blue clone found by Gladys in the Fish River Valley on the Farm Plutovale. These plants are typically *Clivia* to look at, but with a purplish staining at the base of the leaves. This cross, made in 1908, may, if I am lucky, flower for me this year, 1985.

Also just beginning to flower this season is *Clivia miniata* X pollen sent to me of sweet scented *Narcissus tazetta*. The first opening flower is scented and with a lot of yellow in the center of the flower. It is yet too young and under-developed to evaluate.



Figure 7. A large, near-white *Clivia* from Gladys Blackbeard's collection. G. McNeil photo.

CONSIDERATIONS IN CLIVIA

WARREN J. GLOVER

EARLWOOD, SYDNEY, NEW SOUTH WALES, AUSTRALIA

The *Clivia* season was poor this year (1984). Only one of the clones of *C. miniata* var. *citrina* flowered [cf. *Herbertia* 40:102(1984)]. I have three plants but suspect that there are only two separate clones. One, B314, has a potyvirus infection and is extremely slow growing. The virus mosaic contrasts strongly on the dark leaf and even new leaves show clear signs of the virus. This plant is an obvious contender for the acetylsalicylic acid treatment. Of the eight or so potyviruses known to infect the *Amaryllidaceae*, Hippeastrum Mosaic Virus (HMV) is the most likely villain, so our main concern is that aspirin will be as effective against HMV as against TMV.

The 1983 season was more fruitful than that of 1984. A plant I purchased from a local dealer as *Clivia* 'Aurea' turned-out at best to be a seedling of *C. "aurea"*, an undistinguished pale apricot. Hoping that the gene pool would still have some genes for yellow flowers, its pollen was placed on *C. miniata* var. *citrina*. The hybrid was designated CL83-20 and nine seeds were subsequently planted in sphagnum moss. I suspect that cultivar names for the cream/yellow flowered *Clivia miniata* have proliferated with each collector and nursery. Names similar to 'Aurea', such as 'Aura' and 'Aria' have been encountered. Whether they represent the same clone or not is arguable, but I think the names are no more than derivations. Other names for these plants are *Clivia kewensis* var. *bodnant* and *Clivia miniata* var. *flava*. While accepting that there are many variations within the coloring of the cream/yellows as well as considerable vegetative variation, the National Botanic Gardens of South Africa recognizes only the name *Clivia miniata* var. *citrina*. In a letter dated 16 January 1984, G. W. Duncan of Kirstenbosch Botanic Garden stated "...the yellow forms of *Clivia miniata* are regarded as natural 'sports' which should produce a high proportion of yellow-flowered progeny. The correct name for the naturally occurring yellow forms is *Clivia miniata* var. *citrina*, previously known as *C. miniata* var. *flava*."

Extensive enquiries in South Africa, Australia and the U.S.A. have elicited reports that cross-pollination of two different clones of *C. miniata* var. *citrina* does not produce a high percentage of plants with the same traits as the parents. Cynthia Giddy of Natal writes that in 1978 she acquired a second clone *ex habitat*, and cross-pollinated this with her 20 year old clone. After four years, 38 seedlings flowered and all are orange like the

typical species. Plant breeders at the University believe that cross-pollinating the F1 seedlings will cause the recessive genes to combine and the F2 generation will have a proportion of creams. This was done in 1983 and results will appear in 1988.

On the subject of *Clivia*, it is with sadness that I report the passing of George Keith Cowlshaw on 2 October, 1983. I never met Keith but spoke on the telephone to him on several occasions just prior to his death. He was a marvelously interesting plantsman and his dedication covered the complete spectrum from paphiopedilums to camelias, from freesias to anthuriums. His greatest love was for *Clivia*. His tree-shaded acreage at St. Ives, a Sydney suburb, was a mass of *Clivia*. I visited the Cowlshaw home in September 1983 to learn that Keith had been taken to a hospital. The grounds of the home were a carpet of oranges and pinks. Thousands of *Clivias* in flower! In a gesture of great generosity, Mrs. Bon Cowlshaw gave me two of the finest clones, a large orange-pink and a slightly smaller dark orange. I felt distinctly privileged to have a choice from plants developed over a half century of selection and breeding. Keith ranks among the leaders of our earlier amaryllid breeders.

AUSTRALIAN HIPPEASTRUM HYBRIDIZATION

WARREN J. GLOVER

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It was with some anticipation that I awaited the flowering this summer of two hybridizations made in 1981. The first was a miniature, *Hippeastrum* sp. 1525 X *H. (EAE)*. The scape came from a bulb less than 2cm in diameter. The flower exhibits the narrow segments of *H. sp. 1525* and the pale creamy pink of *H. (EAE)* instead of the darker red of *H. sp. 1525* and the superior shape of *H. (EAE)*. A hybrid midway between *H. flam-migerum* and *H. blossfeldiae* was anticipated. Two seedlings flowered, but no significant difference between them was detected. The bulbs off-set well, and a single pot would produce dozens of flowers simultaneously.

The second, from superior parents, naturally produced superior flowers. *H. neopardinum* X *H. dorianae* gave rise to some wonderful pinks. About eight clones flowered in colors from very hot pink to bright lighter pink. None had the pale chartreuse ground color of *H. neopardinum*. Several are outstanding for primary hybrids and one, A905, is a full star-shaped flower with wider segments than *H. neopardinum* that overlap as on *H. dorianae*. The diameter is about 18cm.

This season, of 178 *Hippeastrum* cross pollinations, 93 aborted, 64

have been harvested and 21 remain to be harvested as of December 12, 1984.

My biggest disappointment has been the refusal of *H. escobaruriae* to set seed; however, it flowered in early September, so I had to use pollen that had been stored for 10 - 12 months. This species is very attractive. Of three seedlings, only one has flowered. *H. correiense* failed to accept its own pollen. This plant, while a good red, is similar to *H. aulicum* in shape. Unlike *H. aulicum*, though, it flowers in mid to late September. *H. correiense* pollen was rejected by *H. correiense* var. *compressa*, which I found to be strange for two supposedly closely related taxa. As a parent, my hybrid of *H. neopardinum* X *H. dorianae* was a failure. Particularly disappointing was the rejection of *H. fuscum* by two clones and rejection also of *H. traubii* forma *dorianum*. While *H. neopardinum* has generally been quite receptive, it chose to refuse pollen of *H. brasilianum*. This is a cross I would very much like to make, so despite the disparity of blooming times, I have stored plenty of *H. brasilianum* pollen.

What I consider to be the most interesting successes include *H. fuscum* X *H. (neopardinum* X *yungacense*). The markings on flowers of these species are similar, but shapes vary. The depth and brightness of the reds are comparable, though they are of a different hue. *H. neopardinum* X *H. yungacense* accepted pollen of *H. fuscum* to complete the reciprocal cross, but rejected pollen of *H. brasilianum*. *H. correiense* X *H. correiense* var. *compressa* was more a casual effort as the flowers are not similar but just happened to flower at the same time. To an observer such as I am, there seems to be no reason for these plants to share the same specific epithet, and their relationship appears all the stranger when one accepts the pollen of the other but the reciprocal aborts. *H. correiense* was the seed parent also with *H. neopardinum*. The progeny will be a bold red and green. *H. neopardinum* seems to be dominant for its bright red/pink striations. The reciprocal aborted. Again as a seed parent, *H. correiense* took pollen from *H. neopardinum* X *H. dorianae* (A905). I hope in this cross the green throat and keels will be suppressed, but this rarely happens. The reciprocal cross aborted. *H. vittatum* var. *tweedianum* X *H. (dorianae* X *fragrantissimum*) has promise because the seed parent has pale pink striations on a white background. This flower is larger and more open than the pollen parent. Of the six different *H. dorianae* X *H. fragrantissimum* hybrids, only two exhibit any trace of pink. It will be interesting to see what effect the pale *H. vittatum* var. *tweedianum* will exert in this cross. Another test of the pure white *H. dorianae* X *H. fragrantissimum* will be the crossing with *H. traubii* forma *dorianum* with the latter as the seed parent. This little pink is one of the most graceful and elegant miniatures.

The same cross was effected with two different parents but the reciprocals aborted. *H. neopardinum* is a relatively good seed parent, accepting pollen from two different clones of *H. traubii* forma *doranium*. Comparison of these with A905 and its siblings will be interesting. Other pollen donors to *H. neopardinum* were *H. stylosum*, which should soften the bold star shape and strengthen the striations. In 1981, when I made the first *H. neopardinum* X *H. dorianae* cross, the reciprocal aborted, but this year both hybridizations have produced good seed capsules. *H. dorianae* has accepted *H. stylosum* pollen, which will combine two different shapes. The reciprocal aborted. *H. dorianae* was a successful donor of pollen to *H. X 'Mañanita'*, and in return accepted pollen from *H. neopardinum* X *H. yungacense*. This combination of bright dark red and bright pink should produce some eye-catching colors in three years. The untiring *H. dorianae* has also produced seed in a cross with *H. blossfeldiae*. This is the only species other than *H. anzaldoii* that I have found compatible with *H. blossfeldiae*.

I am still searching for another species compatible with the charming *H. flammigerum*. A back-cross of A905 to *H. dorianae* has produced a capsule. With that last cross-pollination I am allowing my three pots of *H. dorianae* to rest.

One of the brightest events this spring was the flowering for the first time, in September, 1984, of *H. brasilianum*. For a species, *H. brasilianum* is breathtaking. Indeed, it is the largest flower I have seen on a *Hippeastrum* species, and has a most heady gardenia-like fragrance. The flower is a white trumpet 18cm long and 13cm wide. The throat shades creamy yellow to green, deep in the throat. Two scapes produced four flowers. A few wrinkled seeds came from a pollination with *H. (dorianae* X *fragrantissimum*) clone A517. The A517 pollen had been stored since March, 1984. Sphagnum moss proved to be a good planting medium in my experience. Some very old, dessicated seed of *H. calyptratum* X *H. (papilio* X *fragrantissimum*) and X *H. (dorianae* X *fragrantissimum*) germinated very well. With this experience in mind, I am planting seed of these hybrids in sphagnum moss.

H. brasilianum pollen was daubed on eleven different stigmas with poor results. Eight aborted, but seed was harvested from *H. (papilio* X *fragrantissimum*) and capsules are forming on *H. X 'Mañanita'* and *H. (parodii* #1315 X *aglaiae*). The latter is a seedling, flowering for the first time. It produced four small yellow trumpets on its single scape. Obtaining quantities of viable seed from *H. brasilianum* crosses will require a more discriminating and subtle approach than flinging valuable pollen on everything that has a stigma.

That delightful little yellow *H. X 'Mañanita'*, accepted pollen from *H. brasilianum*, *H. neopardinum* and *H. dorianae*; three capsules are forming nicely. Like *H. brasilianum*, *H. X 'Mañanita'* is very choosy, and would accept no pollen on previous occasions. It will be interesting to see the results of the mating in about three years.

There are now four cream/yellows in the collection: 1) *H. evansiae* (clone A707), 2) Cothran's hybrid #339, 3) *H. X 'Mañanita'*, 4) *H. (parodii #1315 X aglaiae* - clone A533). I have not found any compatibility between these taxa. However, with improved pollen storage facilities I hope to attempt every combination, and include *H. brasilianum* among them.

QUEST FOR LARGE, YELLOW HIPPEASTRUMS

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Hybridization for large, yellow Hippeastrums has been going on for several years. This work has resulted so far in 'Chatterbox' and, later, 'Yellow Pioneer'. Attempts continue to improve the size, form and depth of the yellow color. An update of this quest for large, yellow Hippeastrums was made in *Herbertia* 40:105 (1984). That report concerns the irradiation of *Hippeastrum* seeds to induce genetic or chromosomal changes which might lead to improvements in both flower size and color. Only three or four plants of *Hippeastrum* raised from those irradiated seeds flowered in 1983. It was noted then that the flowers were very interesting, but that no seeds were obtained from the flowers.

The irradiated seeds were obtained from a cross of 'Irish Summer' and 'Limeade' (a sibling) on 'Yellow Pioneer' and on a very similar sibling. The plants are mostly robust and grow well.

In 1984 most of the plants bloomed at almost the same time, which facilitated selective pollination. Table 2 briefly describes the flowers from each plant. Each progeny line has an associated numbering system, i.e. 1219 is a progeny line number and the hyphenated 1 following designates an individual plant.

'Yellow Pioneer' probably has a diploid genome and is self-fertile, although it accepts pollen from both diploid and tetraploid plants. It produces a large capsule which has many large, black seeds. 'Irish Summer' is thought to have a tetraploid genome. It has not set any seed with pollen from 'Yellow Pioneer' but has done so with other large-flowered Hippeastrums.

In the hybridization program, each hybrid was self-pollinated on half of its flowers in an attempt to get selfed seed. The remaining flowers were pollinated by a suitable member of the group. Two of the irradiated hybrid progeny had one flower each pollinated by 'Yellow Pioneer'. Only a few capsules were obtained, with very few seed in most of them.

The seed from the above crosses were sprouted in jars of water using all of the seed obtained, except those from the capsules of 'Yellow Pioneer' and Plant #716-1. Table 3 summarizes the data from this portion of the hybridization program.

Some of the 111 plants noted in Table 3 were weak and their potential for growth doubtful. The single selfed Plant #1220-4 capsule did produce 10 plants and every effort will be made to bring some of them to maturity.

Three of the irradiated plants that flowered in 1984 were very pretty. Plant #1219-11 was a lovely Orient Pink, with deeper pink veining. Plant #1222-1 had very large, mostly white, flowers and very wide leaves. Plant #1221-1 had pale pink veining on a pink ground. All three of these flowers were considered to be show quality.

It should be noted that from the 21 flowering Hippeastrum plants, with a total of 71 flowers pollinated, only 10 seed capsules were produced. If the three capsules involving 'Yellow Pioneer' are excluded, only 7 capsules were produced. Of the desired "self's", only one capsule with 10 viable seeds was produced. It will not be known if this is an acceptable characteristic until the progeny flower.

TABLE 1. YELLOW HIPPEASTRUM HYBRIDIZATION PLAN AND ACCESSION NUMBER

Hybrid number	Cross	Plants in Experiment
1219	591-4 X 'Irish Summer'	12
1220	'Yellow Pioneer'	5
1221	'Yellow Pioneer' X ** 'Lime B'	2
1222	*591-4 X *** 'Lime A'	6
Total		25

*Sibling of 'Yellow Pioneer'

**Sibling of 'Irish Summer'

TABLE 2. CHARACTER OF HIPPEASTRUM HYBRIDS

Hybrid Number	Number Flowers	Size in Inches	Description
1219-1	4	8	Yellow with pink veining, becomes white later
1219-2	2	10	Strong yellow, pink veining, very flat
1219-3	2	7	Chartreuse green with green throat
1219-4	3	8	Chartreuse yellow, pink veining, very fine
1219-5	4	7	Cream with pink veining
1219-6	4	7	Pale yellow, throat bright yellow green
1219-7	3	8	White with many pink veins
1219-8	4	7.5	Faint pink veining on cream
1219-9	4	7	Opens yellow green, becomes cream, throat green
1219-10	4	6	Primrose yellow with red picotee-handsome
1219-11	4	7	Orient pink, deep pink veining, green throat
1219-12	3	7	Glisteny white, yellow on ribs
1220-1	3	6.5	Cream with red veining, yellow on ribs
1220-2	4	7	Segs white, throat green, yellow on ribs
1220-3	4	6.5	White, broad segs, ruffled, pink veining
1220-4	3	8	Opens cream, fades to white
1220-5	2	6.5	Segs narrow, opens poorly, not imbricated
1221-1	4	7	Wide pink segs, pink veining, well imbricated
1221-2	4	7	Destroyed, color break, possible virus
1222-1	4	8.5	Opens white with some yellow. Very wide leaves
1222-2	2	8	Opens yellow, fades to white, very flat
1222-3	4	6	White, some yellow, broad segs, round type
1222-4	4	6	White, pink veins, yellow star in throat
1222-5	3	7.5	White, pink veins, deep green throat
1222-6	4	5.5	White, segs waved, green throat, imbricated well

TABLE 3. CROSSES FROM WHICH SEED WERE OBTAINED

Seed Parent	Pollen Parent	Seedlings Obtained	Accession Number	Comments
* 591-1	1219-4	20	1334	Large black seed, 90% germination
591-1	1219-3	14	1336	Medium large, black, 95%
1219-7	1219-3	4	1344	Poor seed, plants very weak
1219-7	1219-3	8	1345	Brownish, medium size, 50% germination
1220-4	1219-4	13	1343	Very few seed in capsule
1220-4	Self	10	1347	Papery brown seed
1220-3	1219-6	15	1350	75% germination
**716-1	1222-1	14	1351	Seed black, medium size, 93%
1220-3	1219-6	8	1352	80% germination
1219-7	1219-3	5	1358	5 rolled seeds, 100% germination

*591-1 is 'Yellow Pioneer'

**716-1 'Yellow Pioneer' X self

COMMERCIAL HIPPEASTRUM CULTURE IN CALIFORNIA

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BIOGRAPHY

My grandfather, along with about 65 other families, in a religious movement, emigrated from Russia and settled in Mexico in 1913, where my father was born. I was born there in 1932. They settled in a town called Guadalupe, north of Ensenada, Baja California. My memory goes back clearly to my dad's chili-pepper ranch (about 40 acres), with two horses and a hand dug well. I had two years of schooling in Mexico. My parents had lived for 25 years in Guadalupe when they decided to settle in the United States, in Santa Maria, on the central coast of California.

In those early days there were no jobs available except in agriculture. I remember my mother and myself going into the fields to harvest lettuce, celery, carrots or whatever was to be harvested. My father, an enterprising man, decided to buy a truck to haul manure to every farmer in the valley.

Growing up in "The Valley of Gardens," I became increasingly interested in horticulture. After high school graduation, I took horticultural courses at Cal Poly, San Luis Obispo at night and began such courses as transplanting, fertilizing and soil development, the last of which turned out to be my greatest interest.

I went into business with my father and we developed specialized mixes for flower and vegetable crops. This expanded our one truck to a fleet of ten. Our focus was on spreading 'material' for each of the crops and we soon became known as M. D. Distributors, (Doctors of the Soil). From that we diversified and I went into the greenhouse business in 1960, constructing a 45,000 sq. ft. greenhouse for transplanting vegetables and work with potted flowering plants for the market.

PRODUCT DEVELOPMENT

Through the years my interest in agriculture never wavered. In 1976, when my family was raised, I had time to develop my own interests and discovered *Hippeastrum*! Information in the United States on *Hippeastrum* was sketchy or not even available, so I decided to go to Holland and find out how they propagated this unusual plant. It was only later that I joined the American Plant Life Society, which had a great deal of information

on culture. I soon learned that most of the *Hippeastrums* in Holland were grown in greenhouses. My interest was to grow them in an open field so Californians could grow them outside in their gardens.

Information on field cultivation was hard to find, but I directed all my interests into growing a 'field-hardy' cultivar. Toward this end, I purchased every bulb available for 'field hardiness,' most of them from the Ludwig and African strains. After experimenting with three different field locations, I finally found the ideal locale for field-hardy bulb production.

PRODUCTION

We now plant approximately 2,500 *Hippeastrum* per row in 500 foot rows. The grading of each row is guided by a Laser beam, giving very close slope tolerances. Laser beaming my entire field controls the watering, which is one of the major concerns. It also controls and insures uniform planting depth and in turn uniform root length in the bulb. This expensive investment pays off in the elimination of extensive hand labor in the harvest. With the proper equipment at our disposal we are now able to dig a 500 foot row of *Hippeastrum*, that is about 2,500 bulbs, in about 10 minutes, getting the right leafcut and the right depth to the root.



Figure 1. Planting bulbs for the new crop. Supreme Bulb photo.



Figure 2. Digging of bulbs with specialized tractor. Supreme Bulb photo.

Figure 3. Field cleaning of bulbs. Supreme Bulb photo.





Figure 4. Field-planted crop in flower. Supreme Bulb photo.

Through our experiments we have developed our own planting mix which we have determined is exactly what *Hippeastrum* needs. We analyze our soil for the proper pH and phosphate levels. We may continue with foliar feeding if this is found necessary after testing. We use very little fertilizer in our water since most of the nutrients come from the mixes we have developed, often involving as much as 15 yards of mix per acre.

RESEARCH AND DEVELOPMENT

In the development of my business, meeting Ivan Kenny was a fortuitous event. Ivan has had over 40 years of experience in genetics with plant development and *Hippeastrum*, while my experience in this area, at the time, was limited. In 1982 Ivan Kenny, whose background is too extensive to mention here but with credentials to be envied, along with his recognition in the field, joined as a co-partner and plant breeder in the research and development of new *Hippeastrum* hybrids. This was a decided asset for our future goals and plans.

We set aside 4,000 square feet of greenhouse space for breeding *Hippeastrum*. At this time, we have more than 15,000 different crosses which Ken is helping develop into new hybrid selections. Some of our objectives include (1) the breeding of bulbs free of such disease as mosaic virus and *Stagnospora*, (2) field-hardy bulbs, able to winter-over in southern California, and (3) perhaps a fragrant strain which is among the many more desirable qualities of the *Hippeastrum*. We have also developed a *Hippeastrum* with 10, six inch, outward-facing flowers on a 24 inch scape. We are searching for other pastel colors, including pink and yellow, as well as outward-facing flowers. These features must come from additional breeding.

Another break-through has been in my being fortunate enough to have had Mr. Wes Keyes as a mentor. After his death, I was approached by his family, who requested that I continue his work. He had developed 26 colors of *Hippeastrum* through cross-breeding over a ten year period. He had some of the Mead, Howard and Smith strains, and many American and Ludwig strains. We already have some F1 hybrids which we will be able to market in the near future. Keyes' *Hippeastrum* are mostly based on in-bred lines. He developed the Keyes' F1 Hybrid Amaryllis, using American techniques. His work added to my own over the years and we now have a wide selection of *Hippeastrums*, one of which we are very proud of, since it blooms during the Christmas season.

Due to growing conditions in California, we are able to produce an excellent spring-blooming bulb. Most of our *Hippeastrums* are planted by March 15 and no later than April 10, and we start digging them by October 1st through the 15th. At the present time, we have 16 acres of *Hippeastrum* and we are hoping to increase the colors and varieties of field-hardy types. We also have a research project in Mexico, close to Mexico City, which may allow us to get closer to the Christmas season market. Holland has a good Christmas market, as does South Africa.

Our hope with this research in Mexico is that we can compete with the Holland market. I believe in the near future we will be successful in that area, especially with the new hybrids we obtained from Keyes. This was a big step for us and using his hybrid strains has saved us 15 years of research.

We will have 16 acres in plantings this year, and, with the use of computers, will store all of the information obtained from past, present and future research on *Hippeastrum*. The help of the American Plant Life Society and those breeders with whom I have come in contact has proven invaluable. Their encouragement and advice has given me the impetus I need to continue in this field. New discoveries are just around the corner or in the next plant. We hope to supply the market with bulbs that have the qualities we are aiming for in the coming years.

A SECTIONAL CHIMERA IN HYBRID HIPPEASTRUM

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Variation in plants is not new. John Worlidge (1677) reported it for the first time in some plants growing in the woods. Since then a number of garden plants have been discovered showing variegation. Kirk & Tilney-Bassett (1967), Nielson-Jones (1969) and Bennett (1964) have reviewed the literature. Trade names like 'Variegata', 'Discolour' and 'Marmorata' have been coined by nurserymen for such mutants. Despite difficulties in their propagation, these pied beauties have secured an important place in modern gardening.

Presently variegation has been classified as a group of plants (Bailey, 1913) where leaves become striped, banded, spotted or blotched with yellow, white, red and various other colours, compared with the normal green portion of the leaves.

In the present case, a sectorial chimera caused by somatic mutation has been discovered in a hybrid clone of *Hippeastrum*, 'Reetka' (Figure 1) which is normally red-flowered.

In *Hippeastrum*, this chimera is of special interest because of its unique colour pattern; the two colours, red streaks over white, appearing side by side in the flower. Figures 1 & 2 show the variegated plant and normal flower colour characteristics. The colour pattern of the tepals is decidedly different in the two blooms. The mutated plant was perfectly healthy and vigorous in growth and the flowers were otherwise beautiful and ornamental. The new cultivar is called 'Tarang'.

Work over the past half century has shown that variegation occurs mostly in plant foliage. However, *Dahlia* (Shamel, 1918, 1919), *Gladiolus* (Collins, 1919), *Canna* (Blachly, 1940), *Nicotiana tabacum* (Stino, 1940), and *Petunia* (Nielson-Jones, 1969) are among other examples wherein variegation has been recorded in the flower. Some colour chimeras are noted in fig fruit and grains of maize (Collins, 1919). Shamel (1919) believed that a chimera had been responsible for the origin of most valuable cultivars of *Dahlia*.

The causes which result in variegation are not exactly known. However, the mechanism involved for such changes has been ascertained. Variegation may arise due to presence of some additional pigments which usually produce red or purple variegation. The green, white and yellow variegations are primarily caused by differences in the amount of chlorophyll.



Figure 1. Normal 'Reetka' clone of *Hippeastrum*. P. Narain photo.

Figure 2. Chimeric 'Tarang' clone of *Hippeastrum*. P. Narain photo



The variegation caused by additional pigmentation usually arises as the result of mutation whereby the cells lose their ability to produce chlorophyll and associated pigments. When the cells lose their ability to produce pigmentation, the tissue appears white. If the loss is partial, yellow or gold colours may appear.

While the absence of chlorophyll or presence of pigments are the principal causes of variegation, it sometimes results from certain diseases. The most common disease is caused by mosaic-virus. In this case, infected plants are usually unattractive and sickly in appearance.

In the variegated plant tissue, two or more genetic lines usually exist side by side. This is called a chimera. A word derived from the Greek Chimaera, meaning a monster formed of parts of different beasts. In the literature, the word chimera crops up as a symbol of anything strange, uncommon or a mixture of incompatible elements and thus the term chimera was introduced into the botanical literature (Nielson-Jones, 1969).

Three types of chimera have been differentiated. These are periclinal, sectorial, and mericlinal, based on the pattern of mutated and normal plant tissues of their complements.

In the periclinal chimera, different layers of cells fit within one another, like a hand in a glove. If a cross section of such stem is seen, each different layer would appear encircling the other, producing concentric circles. The foliage produced by periclinal chimera has more or less concentric rings. However, because not all cell layers extend to the edge of a leaf, variegation results. A green layer over a white layer produces leaves with a green margin and a white core.

In the sectorial chimera, one area of cells exists beside another, like slices of pie, extending to the periphery from the center of the stem. The most important example of sectorial chimera is *Iris pallida*.

The variegated pattern produced by a sectorial chimera depends on the structure of cells involved in it. There may be green leaves on one side of the plant and white on the other. For example, leaves may be half green and half white. Sometimes in a sectorial chimera the variegated plant often produces entirely white shoots which are so mal-adapted that they eventually die. Normal, entirely green shoots are usually so vigorous that, if left to flourish, they will overwhelm the variegated leaves or stem shoots on most of the plant. These vigorous stems must be pruned back if the foliar variegation is to be maintained.

The third and most common type of variegation is mericlinal, which is an intermediate condition between the periclinal and sectorial chimeras. A mericlinal chimera is composed of aberrant cell-layers which incompletely overlap normal layers and vice versa. An important example of a mericlinal

chimera are the Japanese maples which produce leaves which are sometimes white, green and spotted white or even pink.

The lack of chlorophyll in stem and leaf tissue means that variegated plants are less equipped for survival than normal plants. Their leaves are smaller and they tend to be more tender and sensitive to heat/frost and drought. They are generally less vigorous than their normal green-leaved counterparts.

Variegation, once manifested, may be perpetuated by asexual propagation.

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HIPPEASTRUM CULTURE 1958 to 1985

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[This paper was prepared for use as a chapter in the revision of the Traub "Amaryllis Manual". The discovery of several new species, changes in nomenclature and lack of funding have indefinitely delayed the production of a new "Hippeastrum Handbook". Rising above all this, Dr. Whitaker's paper is cogent and presented here.]

INTRODUCTION

Hippeastrum growers have wrestled with the problem of the best method to culture these lovely plants for years, mostly with limited success. The plants are not that difficult to grow, but to maximize the production of quality foliage, followed by attractive flowers, is not easy. A rudimentary knowledge of light, temperature, water and nutrient needs of these species is essential for producing the best flowers.

Among the first to recognize the great diversity of habitats among amaryllids was William Herbert, a lifelong student and authority of the Amaryllidaceae. He states "There is some difference as to the cultivation of the various species of *Hippeastrum* (*Amaryllis*), in consequence of the several latitudes, altitudes, and situations in which they are found. Capricious watering is their bane; they should be watered pretty freely while they are making leaves, more sparingly after they are grown, and not at all when at rest" (Herbert, 1837, pg. 147).

The genus *Hippeastrum* is, for the most part, indigenous to the south-eastern and western portion of the great Amazon Basin of South America, which includes parts of Brazil, Paraguay, Bolivia and Peru. In addition, their range extends into northern Argentina and adjacent Chile. These areas are mostly sub-humid, tropical jungles with a pronounced dry season. In designing a cultural program for *Hippeastrum*, some hints about their cultural requirements can be obtained by considering the environment in their native habitat.

Despite the fact that the center of distribution for *Hippeastrum* is the tropical Amazon area, the genus has become diversified and radiated into other than jungle-like habitats. For example, I have collected *H. cybister* on the road between Cochabamba and Santa Cruz, Bolivia (type locality) where the plants were growing on a dry, stony slope (altitude about 5000 ft.). They were fully exposed to the tropical sun, surrounded by a xerophytic

community, including at least one species of cacti. On the other hand, I have collected *H. pardinum* in the jungles of the Bolivian yungas east of La Paz, Bolivia, where the plants were growing in dense undergrowth in full shade at an elevation of about 5000 ft.

Doran (1972) describes the habitat of a number of species, translating these observations into suggestions for the culture of several species. Generally most species grow in forested areas in a mixed understory, where they receive a reasonable amount of light, the humidity is high, and the soil is protected from the direct rays of the sun. Under cultivation the plants should not be exposed to high air and soil temperatures accompanied by low humidity as they are likely to be damaged.

An example of the extreme diversification within *Hippeastrum* is the aquatic *H. angustifolium*. According to Gomez-Ruppel (1970) it grows submerged in the muck of swamps along the border of the provinces of Misiones and Corrientes in northern Argentina. The long-necked bulb carries foliage and flowers above the water. The bulbs have been successfully cultured in the United States by Williams (1970). This discovery points out another interesting habitat to which *Hippeastrum* have become adapted. It perhaps opens the way for breeding *Hippeastrum* adapted to aquatic habitats.

POTTING MIXTURES

In the United States, except for Southern California, Florida and certain parts of Texas, where *Hippeastrum* are raised outdoors to a limited extent, they are grown in pot culture. Acceptable ingredients for potting mixtures have baffled *Hippeastrum* growers for years. Many recipes have been concocted for potting mixtures, none completely satisfactory. It is generally agreed, however, that the essentials of a good potting mixture are: (1) a high porosity potting medium; (2) perfect drainage; (3) good root aeration; and (4) avoidance of most organic materials in the mix (Mertzweiller, 1969; Cagle, 1975). Whitaker (1976) summarized potting mixtures in use by knowledgeable growers at the time. The ingredients in these mixtures are basically the same, but proportions differ. Also, ingredients that retain their physical properties over a period of years should be used because repotting is a severe shock to the bulb (Doran, 1982).

The perfect potting mixture has not yet been devised, but the ingredients and proportions suggested by Doran (1974) and given below could serve as a model. This mixture can be modified by the grower to fit specific conditions. As pointed out by Doran (1982), the mix should be altered to match climate, and watering practices:

- 2 parts organic (peat)
- 3 parts sponge-rock #3 (coarse)
- 1 part charcoal #10 mesh
- 2 parts vermiculite #3
- 2 parts fine sand

To this mixture are added one-half teaspoon of lime and one-half teaspoon of superphosphate per 6" pot. More lime may be necessary to bring the mixture to pH 7. Hydrated lime changes the pH immediately, and should be used only to bring the mixture to the correct pH. If so, powdered Dolomite should be added in amounts necessary to buffer the mixture, thus stabilizing it at the correct pH. The pH of a mixture is easily determined with litmus paper or simple pH indicators. Such instruments can be purchased from most nurseries. These indicators are relatively cheap, but a wise investment for the discriminating *Hippeastrum* grower.

The potting mixture should not stray significantly from pH 7. Doran (1982) is very firm on this point. He states "pH of the soil should be maintained as close to pH 7 as possible. Below pH 6.8 invites trouble, and over pH 7.5 blocks off some nutrients." It is important to drench regularly at 2-3 month intervals with Benlate or a similar fungicide to control root fungi.

LIGHT

Among other environmental conditions for the successful culture of *Hippeastrum*, light is of paramount importance. The area in South America where most *Hippeastrum* species are indigenous is located only a few degrees latitude south of the equator (10° to 20° South latitude), and usually at high altitudes (4000 ft. or more). It follows from their location that these areas are subject to intense tropical sunlight.

J. L. Doran (1982), the dean of *Hippeastrum* cultural experts, advocates full sun, from sun-up to sun-down. My experience with *H. aulicum* indicates this suggestion has merit. Where the bulbs were grown in full or one-half shade, they bloomed erratically, although the plants thrived. In full sun the bulbs produced scapes each year. Partial shade is permissible, but, in general, Doran's dictum of continuous full sunlight is best to follow, if possible.

TEMPERATURE

Since *Hippeastrum* is primarily a tropical or sub-tropical genus, it is not unreasonable to anticipate the plants will respond to high temperatures

both day and night. Doran (1982) suggests up to 90°F. day and not lower than 60°F. at night during the growth cycle. Even in Southern California desirable temperatures cannot be maintained for maximum growth unless the grower has access to a greenhouse of some sort. Temperatures lower than 50°F. can be detrimental to most species of *Hippeastrum*. Some species, however, can endure a light frost, but they are slow to recover.

WATER AND FERTILIZER

The timely application and amount of water is most important for successful *Hippeastrum* culture. Watering practices should be adjusted to prevent the plant from being stressed for lack of available moisture, and at the same time avoid continuous saturation of the soil mass in the pot. Normally, the soil should be fairly dry before watering, followed by a heavy irrigation which will not only provide moisture, but tend to leach excess salts from the soil, thus preventing a saline build-up.

Poor growth of *Hippeastrum* in pots can often be traced to improper watering and poor drainage. There are no precise indicators of water stress; therefore much depends upon the skill and good judgement of the grower. Tensiometers can be helpful for indicating the moisture condition of the soil, but these instruments are relatively expensive, and their use requires some practice and proper interpretation.

Fertilizer is usually applied in liquid form. There are several mixtures sold under trade names that are good, e.g. Miracle Gro, Rapid Gro (Cage, 1976), and others. Growers should avoid feeding solutions that contain manure, compost, leaf mold, and other organic materials. Additionally, organics such as urea and ammonium salts should not be used. On occasion, the slow release fertilizer Osmocote can be used to advantage.

Doran (1982) through trial and error has devised a fertilizer formula that works well in Southern California. It can probably be adjusted for use in other areas. It follows that the grower must have time to assemble the ingredients and equipment, combined with the technical skill to prepare simple solutions. Actually the procedure is rather simple, once the ingredients and equipment are on hand. Doran's formula is given below. Micronutrients are added to the solution, if needed. Calcium, magnesium and phosphate precipitate immediately when combined in a water solution, therefore they should be applied separately for best results.

Nitrogen - (NO_3)75 parts per million (ppm)

Phosphate (P_2O_5) - 40 ppm

Potassium (K_2O_3) - 90 ppm

Calcium (Ca^{++} ion) - 80 ppm

Magnesium (Mg^{++} ion) - 9 ppm

Sulphate ($SO_4 =$ ion) - 35 ppm

Most species of *Hippeastrum* in nature are dormant at some time during the growth cycle, usually during the dry season. Under cultivation this condition must be simulated if the bulbs are to flower. Several species become deciduous or nearly deciduous during the dormant phase. At this time water must be withheld, otherwise the bulbs will not produce a scape or scapes.

Van Woesik (1969) and later Lorz (1981) give specific directions for the mass production of *Hippeastrum* bulbs and seedlings in Holland and Florida, respectively. Their methods are essentially similar, but differ in detail. Under the Lorz regime seeds are planted immediately after harvest (usually in June), and the young seedlings are lifted at the end of the second season's growth and replanted at wider spacing where they will flower during the third year. At this point selections are made, and another breeding selection initiated. The plants are grown in beds, under shade of deciduous trees, which provides protection from full sun in summer, but exposure to mostly full sun in spring and fall. A light pre-plant application of a complete fertilizer is broadcast (6-6-6 or 10-10-10) over the beds, followed by watering to wash the fertilizer into the root zone.

For outdoor bulb culture, Van Woesik (1969) plants in beds made by excavating to a depth of 14 inches. The soil is replaced with a mixture of 1/3 leaf mold, 1/3 sand and 1/3 peat moss, and bone meal is added at the rate of 25 lbs. per 25 sq. ft. This mixture provides good drainage and some water retention for the bulbs. Van Woesik suggests feeding on a regular schedule with liquid fertilizer, liquid sheep, cow or horse manure. The bulbs are lifted in the fall, packed in crates or well-vented boxes, and placed in a cool, dry, frost-free area to await planting.

In conclusion it is apparent from this brief review that the culture of *Hippeastrum* has made substantial gains since 1953, particularly in the production of healthy, vigorous plants. Most improvements can be attributed to (1) better potting mixes, (2) the development of new and improved fertilizer mixes, (3) more realistic watering practices and (4) an understanding of the behavior of the dormant bulbs.

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AMARYLLIS BELLADONNA UNLUCKY INDOORS?

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Between March, 1982 and October, 1982, members of the London-based Folklore Society conducted a survey of plants which are believed to produce misfortune if gathered or brought indoors. A list of approximately 75 such plants was compiled, and although most of the information came from various parts of the British Isles, a number of items were received from other parts of the world. From the State of Victoria, Australia, came a note about *Amaryllis belladonna* L. being considered 'unlucky':

"My mother's family were of Kent origin, and she seemed to be steeped in superstition!! . . . it was supposedly unlucky to bring what we call Pink Belladonna Lilies (*Amaryllis*), also known, I believe, as 'Naked Ladies', into the house. . . ."

Although no other information on *Amaryllis belladonna* was received, experience has shown that such items usually represent widespread folk belief, rather than the belief of an eccentric individual. Therefore, any further information on the folklore of *Amaryllis belladonna*, or any related plants, would be greatly appreciated, and should be sent to: The Honorary Secretary, The Folklore Society, c/o University College, London, Gower Street, London, WC1E 6BT, United Kingdom.



Figure 1. *Amaryllis belladonna* var. *pallida*, luckily growing out of doors. APLS photo.

LUTHER A. BUNDRANT

AN AUTOBIOGRAPHY

In an old farmhouse near Ireland, Texas on November 1, 1926, I was born. That day my father planted a cottonwood sapling. Whether the planting of a tree by my dad to mark the day of my birth had a significant bearing on my interest in plants at a very early age, I do not know. What I do know, though, is that at the age of three I remember lying on my belly eating dirt while staring at the rain lilies, crow poison, and wild onions. At the age of five I collected my first wildflower on the creekbank, and planted it on the bank of the windmill pond.

Then there was school, the U.S. Navy (World War II), college, marriage to Ollene Brunson, the birth and rearing of a son, Mike, years of spelunking, and work, with no plant activity other than to exchange plants or seeds and take a course in biology in high school and another in college. Elementary biology is the only formalized training I have had with plants, but because of my intense interest, over the years I have, on my own, studied botany and genetics to some extent. Although there were always a few pot plants grown when circumstances permitted, there was no real purpose or direction.

In 1956 I settled down to a Civil Service career in Industrial Engineering with the Air Force in San Antonio, Texas. Due to a move from one neighborhood to another in 1962, I met Dr. Thad Howard, who is more responsible than anyone in giving my plant work both direction and purpose. The direction was to specialize in several members and former members of Amaryllidaceae and the purpose was to produce new and hopefully better hybrids than had ever before been produced.

Looking forward to retirement, in 1975 ATASCOSA GARDENS was founded, on a sandy hill with another old farm house and another old windmill, between San Antonio and Poteet, Texas. Retirement actually took place in January 1982. The move was only forty-five miles but a world away in terms of plant culture—from a limestone hill with many rocks and almost no soil to pure deep sand. The digging is now easy. I think the reason Ollene insisted on this place was that she had become increasingly more fearful for my health as she watched me dig rocks in the heat of the south Texas sun. Here I have been able to pursue my interests in growing and hybridizing amaryllids which I love so much. Now at age fifty-seven I no longer lie on my belly eating dirt but I do ingest a lot while digging

the loose sand. You might say that from age three I've had a real love for the soil.

Currently, while Ollene takes care of the business of ATASCOSA GARDENS, I am hybridizing *Crinums* and *Hymenocallis*. In the recent past I worked with *Sprekelia* with little success, and extensively with *Polianthes*, *Bravoa*, *Manfreda*, and *Prochnyanthes*.

Over the years I have learned much about the plants with which I have worked, but the most important thing perhaps is that while obtaining new hybrids is relatively easy, getting truly good hybrids occurs very rarely. I shall continue to try.

POLIANTHES TUBEROSA AND ITS HYBRIDS

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Polianthes hybridizing efforts to date have utilized the old-fashioned "tuberosa" (*Polianthes tuberosa* L.). This is mainly due to its ready availability, large flowers and outstanding fragrance. There are several cultivars of tuberosa: a double, called "The Pearl" or "Dwarf Pearl Excelsior"; one or more variegated forms; and a single form, usually called "Mexican Single" but sometimes "Mexican Ever-blooming". It is the last of these three that has been used in my breeding program as both seed parent and pollen parent. My tuberosa was given to me by a local nurseryman in San Antonio, Texas about 1972.

I mention this because soon after I began to produce my own hybrid plants, the question was raised by one authority as to whether or not I was using the commercial tuberosa. That question implied that only one "Mexican Single" tuberosa was in commerce. Since the tuberosa has been in cultivation for nearly 500 years, and at least three distinct cultivars are known and are assumed to have originated through mutation, it seems only reasonable that more than one form of "Mexican Single" would now be in commerce.

In this light, Gentry (1972) states that *P. tuberosa* L. has filaments 4-5mm long. Verhoek-Williams (1975) states that *Polianthes* subgenus *Polianthes* has an inflorescence with 3-8 nodes. My plant has no filaments as such, but rather has the anthers attached to the tip of small cone-shaped structure near the mouth of the tube. These small cones can be easily observed with a magnifying glass. As to the number of nodes, there are





Figure 5. *Polianthes X blissii*. T.M. Howard photo. (left)

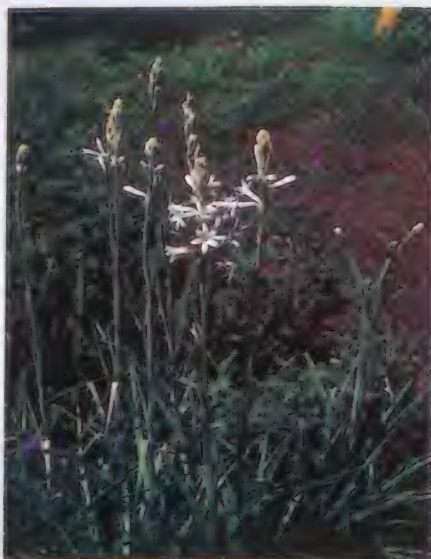


Figure 6. *Polianthes tuberosa*. T.M. Howard photo. (right)

31 on the only scape now in bloom (December, 1984), nine without flowers and 22 with flowers. This plant is typical of a well-grown tuberose in this area (south-central Texas), but considerably larger than plants not given good care. It has 15 basal leaves from 30-65cm long and 1.6-2.5cm wide; the older leaves are the widest and the younger leaves the longest. They are all channeled, but the older leaves tend to flatten-out at a point near half their length and taper to an acute tip. The younger leaves are more deeply channeled and remain so throughout their entire length. Leaf color is a dark, dull green with reddish striping underneath in the lower half. The inflorescence is a raceme with leaf-like bracts, one per node, becoming shorter in length as they ascend. The first flowers appear at the tenth node 107cm above the crown of the plant, the last flowers on the 31st node 140cm from the crown. Flowers occur typically in racemes, with two flowers per node. On this particular raceme, the third and fifth floral nodes had

Figure 1. *Polianthes tuberosa* X P. "73-75" 'Sunset Tuberose'. Ollene Bundrant photo.

Figure 2. *Polianthes howardii*. Ollene Bundrant photo.

Figure 3. *Polianthes X bundrantii*. Ollene Bundrant photo.

Figure 4. *P. X bundrantii*, from a plant sold by Gladside Gardens. APLS photo.

three flowers, each giving the 22 flowering nodes a total of 46 flowers. Each flower has an ovary 0.9-1.25cm long, a tube 4.4cm long and tepals 2.4cm long by 0.8-1.0cm wide with the outer ones wider than the inner. The tepals open wide, sometimes even recurving, giving the flowers a span of 4.4-5.0cm. Because of an 80-90 degree bend in the lower half of the tube, flowers always face outward except when flowers occur in triads, where the center floret is suberect. They are a waxy white and delightfully fragrant. When superbly grown, this plant will produce a candelabra-like panicle of three racemes. Some pairs of flowers under these conditions may set upon 2.5-5.0cm long pedicels.

The genus *Polianthes* now includes, according to Shinnars (1966), not only those species originally included in *Polianthes*, but all those formerly placed in the genera *Bravoa*, *Pseudobravoa*, *Manfreda*, *Prochnyanthes*, *Runyonia* and the herbaceous species of *Agave*. In 1899, the first hybrid in this group was produced using *Polianthes* (*Bravoa*) *geminiflora* and *P.* (*Prochnyanthes*) *bulliana*, but the first cross involving the tuberose was reported in 1911 as *Polianthes* X *blissii*, a cross between *P. geminiflora* and *P. tuberosa*. Sixty-nine years elapsed before the next hybrid was recorded. Susan Verhoek-Williams (1975) reported having crossed *P.* (*Manfreda*) *virginica* with *P. tuberosa*, obtaining self-fertile plants that looked much more like the seed parent, *P. virginica*, than *P. tuberosa*. While they were intensely fragrant, these hybrids were not thought to have much value as horticultural introductions. She had hoped that they would be as hardy as *P. virginica* and might be of value as a step towards eventually producing a hardy tuberose. *P. virginica*, native as far north as Ohio and West Virginia, is the hardiest of the genus.

Howard (1977 and 1978) reported the first two of my hybrids, a repeat of *P.* X *blissii* and a new cross, *P.* X *bundrantii* (*P. tuberosa* X *P. howardii*). Since *P. geminiflora* occurs in two forms, one with slightly glaucous, red, thin-walled flowers, and another with thick-walled, bright orange flowers, clones of *P.* X *blissii* are variable in both substance and color. Flowers vary in color from reddish-pink without, pinkish-white within, to salmon or peach outside and whitish-yellow inside and are displayed on a loose raceme in 12 to 16 pairs. To obtain this cross, all flowers on ten scapes of *P. geminiflora* were dusted with pollen of *P. tuberosa*. The result was six seed pods, three on one scape, two on another and one on still another. Seven out of ten scapes thus produced no seed. This experiment was conducted outdoors without bagging, but control was assured since the two parents were the only plants of the genus in flower within a mile at the time. In an attempt to get the reciprocal cross, about 100 flowers of *P. tuberosa* were dusted with pollen from *P. geminiflora*, but no seed what-

soever was set. This led me to think that this reciprocal cross was not possible, but that thought was short-lived. I soon grew an open-pollinated tuberosa seed to maturity and it turned-out to be a *P. X blissii*. An insect or bird was successful where I had failed.

P. howardii, one parent of *P. X bundrantii*, has bright green, succulent leaves in a more or less flattened rosette. The flowers are single at the nodes and rather widely spaced along the stem to form a raceme of up to 48 flowers, the first at about 38cm and the uppermost at 140cm above the basal rosette. These measurements are probably near the maximum for this species. The lower flowers are much more widely spaced than the upper ones. The color of these flowers is most interesting, being red on the lower part of the tube, blending into green on the upper side and the outside of the tepals. The inside of the flower is a very dark maroon in color; so dark, in fact, that it appears black. Crossing this species with the tuberosa produced a plant intermediate in foliage and flower size, but the flowers were colored pink on the outside and mauve to rich purple on the face. Scape height and number of flowers approximate both parents. The flowers are usually paired at the nodes, but the lower ones may be solitary.

Both of the above crosses are between the subgenera *Polianthes* and *Bravoa*, and in them the traits of subgenus *Bravoa* are easily discerned; but of the following two the same cannot be said. The parent of the first of these crosses with *P. tuberosa* is a small plant with narrow glaucous leaves and *Bravoa*-like flowers, with bright orange-red exterior and orange-yellow interior. It carries the Howard collection number 74-95. While it appears to be a member of the subgenus *Bravoa*, it has very short filaments attached near the mouth of the tube, as in subgenus *Polianthes*. When crossed with the tuberosa, a relatively small plant with yellow flowers streaked red on the outside was obtained. These open well and are quite striking in their delicate beauty. Other equally pretty clones had deep pink flowers. The second parent, Howard collection number 73-35, is much larger in all parts than 74-95, has flowers with a coral exterior and yellow interior, and a perianth shape resembling subgenus *Prochnyanthes*, i.e., the lower part of the tube is small and bends abruptly at mid-point, becoming bulbously inflated beyond. The foliage is bright green and deeply channeled like *P. tuberosa*. Members of the subgenus *Prochnyanthes* have much broader, leathery, dark green leaves. When crossed with *P. tuberosa*, 73-35 produced flowers colored like hybrids of 74-95, but the flowers were larger. The late Marcia Wilson dubbed all *Polianthes* hybrids having yellow flowers streaked red, "Sunset Tuberoses", and lumped all the colored hybrids, including *P. X blissii* and *P. X bundrantii*, into a single group which she called "Rainbow Tuberoses".

In addition to those tuberose hybrids mentioned, I succeeded in getting another which deserves mention, i.e. *P. tuberosa* X *P. (Manfreda) maculosa*. While these hybrids are intermediate, it seems the second parent contributes more. The plants are robust, the white flowers open well, and since both parents are very fragrant, the hybrids are also fragrant.

All of the above tuberose hybrids are self-fertile, and the F₂ generation looks just like the F₁, but not many F₂'s have been observed. The next experiment to be performed is crossing of the existing hybrids with each other, to try to get back to the size and form of the commercial tuberose. In spite of the interesting beauty of the hybrids, none are as large as the parent. Other experiments need to be made using the double and variegated forms of the tuberose. Some of this work is planned for the 1985 season. With much work and a little good luck, the tuberose will have a larger, more colorful future.

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COLLECTING AMARYLLIDS IN AUSTRALIA

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The following is the result of my experiences gained from a trip from my home, 80 kilometers south of Adelaide, to Daintree in northern Queensland and return; a trip covering a distance of some 11,000 kilometers, which I undertook in three weeks. I travelled with a little helper, my 3½ year old son, Aaron, and managed to locate a wide variety of interesting plants.

The first day I located a colony of *Calostemma purpureum* at Hattah, Victoria. These plants occurred around a lake and in sandy soil, and, upon flowering, revealed a burnt, coppery-orange bell with a maroon blotch in the throat. These plants had approximately 10 flowers per umbel on stems 10 inches tall. Flowers occur in late summer after a summer dormancy of a few months. Leaves appear early in autumn. The leaves of *Calostemmas* are, in general, linear, sessile, ½" broad and up to 12 inches long. Unfortunately, this colony is not overly attractive and is more of a curiosity than anything. *Calostemma purpureum* occurs, in the main, here in South Australia and the flowers have the above characteristics except that flowers



Figure 1. *Crinum pedunculatum*. Alan Lee photo.

are 10-20 per umbel, with colours ranging from almost pure white through pink to maroon, all these colours sometimes appearing in one clump. This particular species is mildly scented and quite attractive.

I have located *Calostemma luteum* at Blanchetown in South Australia. This colony has plants with flowers up to one inch in diameter and resemble miniature daffodils. They are very striking, like candles sticking out of the barren sandy ground. *Calostemma luteum* also occurs in southwestern Queensland in black clayey goo, but are a smaller form of the above.

The next plants located were of the *Crinum angustifolium*/*C. flaccidum* type that are reasonably widespread in the interior of the continent.

At Quirindi, New South Wales, there occurs a superb colony of *Crinum flaccidum* (Figure 1) with flowers ranging in colour from white to deep pink on scapes 1½-2 feet tall. Flowers are 6-10 per umbel. Leaves are linear, 1½-2 feet long, 1-1½ inches wide and bright green.

Throughout northern New South Wales and southwestern Queensland occurs *Crinum angustifolium*, which is similar to *C. flaccidum* except that it is slightly larger and has fewer-flowered umbels. These plants are frequently encountered inland and occur across a great portion of the interior of our country.

Moving over to the eastern seaboard one encounters the tropical forms of *Crinum* that occur from Sydney in the south right up to Cape York in northern Queensland. From my own limited expedition I found a wealth



Figure 2. *Crinum flaccidum*, Quirindi, New South Wales. Alan Lee photo.



Figure 3. *Crinum flaccidum*, white form found along the Murray River system. Alan Lee photo.

of different material occurring in a diverse range of habitats.

With *Crinum bakeri* at Daintree, Queensland, *C. brachyandrum* at Rockhampton, and *C. asiaticum* at Cardwell I observed all growing in either mangrove swamps or on muddy riverbanks. Incidentally, I spent quite a few times parked on my rump after slipping and sliding in this treacherous terrain. These plants have a great ability to absorb water and in a lot of cases resembled aloes, being thick and juicy.

Further south I encountered the *Crinum pedunculatum* forms that occur along inland coastal rivers around Brisbane, Queensland as well as in northern New South Wales at Kempsey and Newcastle. I have also located these plants at Coffs Harbor occurring in pure beach sand. These plants must have extremely good resistance to salt toxicity as they regularly encounter salt spray drift from the Pacific Ocean.

The above tropical species have many flowers in the umbel, some with flowers opening simultaneously, others opening randomly, one at a time. They are indeed beautiful plants with sweet smelling flowers, except for the Kempsey form which, in a word, 'stinks'.

Another *Crinum* worthy of mention, which I have collected on a number of occasions, is the beautiful yellow form of *C. flaccidum*. This semi-rare form occurs near Point Augusta in South Australia and grows in clayey soil and granite-type rocks, with bulbs reaching down some 12-18 inches.

Another *Crinum flaccidum* occurring in South Australia is the white form that is plentiful along the Murray River system (Figure 3). The plants are robust and quite variable in shape, and adapt easily to garden culture.

Leaving the indigenous species, I would like to convey my surprise and amazement at a couple of garden escapes I located during my trip! Just outside Brisbane I came across a beautiful little clump of *Hymenocallis* that were quite happy growing on the side of a railway embankment, oblivious to the rest of the world.

At Coffs Harbor in New South Wales I was delighted to stumble upon a naturalised clump of *Hippeastrum* with up to 7 flowers per umbel, the individual flowers a soft watermelon colour with a white stripe running from each segment back into the throat.

It has now been a year since I embarked on the above expedition, and I am pleased to say that most of the plants have adjusted quite well. I have found from experience that I can over-winter the tropics here if they are kept completely dry. This may seem a bit radical, but it works well with these as well as with *Scadoxus* and *Hippeastrum*.

Any collector would know the feeling of elation upon locating a colony of new bulbs, and this last trip has only just whetted my appetite. I intend to push into the Cape York region and the Gulf country of northern Queensland in the next few years to secure some of the gems that occur there.

Lastly, I would like to thank all my friends here in Australia and in the United States for their guidance and advice about locations.



Figure 4. *Crinum flaccidum*, illustrating variability of form. Alan Lee photo.

EURYCLES, THE BRISBANE LILY, IN TEXAS

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Eurycles amboinensis qualifies as one of the most beautiful amaryllids in cultivation. It has been featured in four articles in past issues of *Herbertia* 12:38-40; 26:148-150; 26:150-151; 27:118-20. I add my own notes on this lovely amaryllid.

In March of 1982, a *Eurycles* was purchased, along with other bulbs, from Marcia Wilson. The bulb was of excellent quality and just starting active growth. It was planted in a 6" clay pot in an artificial medium (Metromix 500) that is relatively coarse yet well-drained. The plant was placed in my newly constructed greenhouse and commenced rapid growth. It did not flower, but was the center of attention due to the magnificent shape of the leaves. I know now why my friend Alek Korsakoff chose it as his favorite amaryllid. Throughout the summer and into the fall the plant was given fertilizer applications every 3-4 weeks. No particular fertilizer was used but all were soluble types, i.e. Rapid-Gro, Vigoro, Peters, with fish emulsion added at times. The over-abundant sun in north Texas was reduced by 70% shade cloth. Humidity was always high as the stone floor is sprinkled thoroughly each morning.

The disastrous winter of 1983 started in December and never really broke until February, 1984. All previous cold temperature records were broken. The literature on *Eurycles* recommends a minimum winter temperature of 55°F. Recorded temperatures in the greenhouse went to 36-38°F, even with a gas space heater. The *Eurycles* went dormant and water was withheld.

Dormancy continued into late April. The bulb was occasionally inspected and found to be firm, however, it showed no inclination to put out new growth. It was May before active growth began and the inflorescence appeared with the new leaves. Development was rapid and the plant was in full bloom by June 15, 1984. Specific notes were made on July 1 as follows: mother bulb 2 1/4" (5.7cm) in diameter; leaves glossy, corresponding to color 143A of RHS Colour Chart. A typical mature leaf has a 10" (25.3cm) petiole, 1/2" (1.2cm) wide and curved into a half-moon shape. The leaf blade measures 11" (28cm) wide and 10" (25.3cm) long with 24-30 distinct ribs running longitudinally. There is one center rib that is the most prominent. The genus name *Eurycles* is of Greek derivation and refers to the leaf shape. The leaves are so attractive by themselves that the flowers seem almost secondary.



Figure 1. Close up of inflorescence showing corona. Marvin Ellenbecker photo.

The flowers are a lovely addition and a sight to behold. The umbel is borne on a 30" (76cm) scape that tapers from $\frac{5}{8}$ " (1.5cm) in diameter at the base to $\frac{3}{8}$ " (.8cm) diameter at the sepals. Individual pedicels measure 2" (5.1cm) long and $\frac{1}{8}$ " (.3cm) in diameter. These bear one flower each, with the exception of two, which carry three flowers each. The flowers measure 2" (5.1cm) wide and are an intense, pure white (155C, RHS Colour Chart). The tepal tube is $1\frac{3}{4}$ " (4.5cm) long, with six unequal tepals, but on the whole the latter are $1\frac{1}{4}$ " (3.5cm) wide by $\frac{1}{2}$ " (1.2cm) wide. A distinct green rib runs down the exterior of each tepal. The flowers have that iridescent, diamond-like sparkling sheen, also characteristic of the flowers of *Nerine*, *Hippeastrum*, etc. What appears to be a staminal cup from a distance becomes individual parts united only at the base. This adds to the beauty of the flower and resembles the cup in *Eucharis* and some *Hymenocallis*. The six stamens are 1" (2.5cm) long and .8" (2.0cm) thick. The filaments are the same color as the tepals. The anthers contrast with the filaments with a strong yellow-orange color (14B, RHS Colour Chart) and measure $\frac{1}{8}$ " (.3cm) long by .8" (2.0cm) wide.

The umbel, or flower-head, is comprised of 24 flowers, 16 of them open at one time, followed by 8 more flowers. The longevity of bloom would have been extended if the swamp cooler had been installed. An onset of high temperatures hastened the end of the flowers. The full period of bloom was about three weeks. Several flowers were self-pollinated with an artists' brush but no seed developed.

In summary, *Eurycles amboinensis* is worth growing for its foliage alone. The flowers are an added bonus and have an exotic appeal which adds to the qualities of this unusual amaryllid. *Eurycles* responds well to greenhouse treatment; it may not be well suited for the window unless extra humidity can be provided. While good light is essential, the plant does well in a greenhouse shaded from April to October (70% shade). Bubble-wrap in the interior of the house further reduces direct sunlight. The author surmises that this is an understory plant in its native habitat that receives filtered light at best. The 36" (.91meters) spread would add a spatial problem for a window sill setting. Geographical distribution is limited to Southeast Asia and northern Australia. It would be interesting to have *Eurycles amboinensis* and *E. cunninghamii*, the only other species, described in their native habitats.



Figure 2. Inflorescence detail of *E. amboinensis*. Marvin Ellenbecker photo.

MARCHING IN THE RANKS

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BALDWIN PARK, CALIFORNIA, USA

It's been years since I first chuckled over the expression "Marching in the Ranks". I don't remember whose story or whose article it was in which I first read and enjoyed the expression. But I do remember it was written by a hybridizer. Later, I discussed the phrase with Leonard Doran.

"Leonard", I said, "do you think that all seedling plants should be out in the army, marching in the ranks?"

Leonard knew what I was talking about right away. "It's the only way to do things if you're hybridizing", he replied.

"No exceptions?", I asked.

"There's no use in pampering the weaklings, no matter how pretty they are", he answered. "If they can't survive and produce with only moderate care while they're out marching along with the rest of the army, get rid of them."

We both agreed that when a seedling is one of a group of similar seedlings, it becomes easier to spot its weaknesses. A seedling's strengths are easily identified by a hybridizer. Too easily they tend to be magnified. A love of work, a keen eye, a hard heart, and a hot fire are still a hybridizer's chief assets.

Since my article, "Repotting the *Nerines* of GREENOAKS," first appeared in *Plant Life* 30:118-120, 1974, thousands of *Nerine* hybrids have marched through the ranks of my personal *Nerine* "army". During those eleven years, I've had about 1500 seedlings bloom. Many are discarded even before they bloom. If seedlings haven't reached certain basic stages of progress in their growth cycle by the time they are three, four, or five years of age, they get the old heave-ho. Anything which hasn't bloomed by the time it has reached the ripe old age of seven is also discarded, no matter how promising the cross. No use in wasting time and effort on plants which display genetic laziness.

A high percentage of the first-blooming seedlings are beautiful. Yet, I save very few, even for a second look during another season. It's too costly in terms of time and bench space, for most first-bloomers show flaws, or, just as bad, show no basic improvements over similar cultivars already available.

Those I do save all have special attributes which, in my view, place them above the others; quality shows.

In spite of pitfalls and hazards, the army marches forward. A few



Nerine: 1-'Mystery', 2-'Surprise Package', 3-'Diablo', 4-'Regency'

individuals stand out from the rest that they can't be ignored.

I'm often asked about my *Nerines*, and about how my breeding work with them is coming. For those people who have been kind enough to inquire over the years, and for those who might be interested now, I'd like to share some of my field notes. These were jotted down while I was observing the plants growing and flowering.

I regret that the parentages are unknown in some cases. Labels break or become illegible even with yearly checks. Then too, one learns as one develops. I have not only switched to a better quality label, but, as a backup system, I now use a stud book which contains my breeding records for crosses made from 1975 on.

Here they are.

'Red Sun'—(Parentage unknown) Beautiful scarlet red. Wide segments. Stout stem. Carries 12 plus flowers on a 15" (37mm) stem. Flowers 2½" (6mm) across; segments overlap at base.

'Classical Jazz'—('Hon. Mrs. Kingscote' X 'Mrs. Cooper') Poise and classical elegance. Flower not large and stem not overly tall. Beautiful, medium dark red color. Almost non-phototropic. Does not bend its stem toward the sun.

'Mystery'—(*Nerine sarniensis* var. *fothergillii* X White seedling) Stem, shape of head, flower size and shape comparable to *fothergillii*. Color is salmon pink, heavily overlaid with blue. Most unusual, extremely beautiful. Different color which has been admired by everyone who has seen it.

'Surprise Package'—('Perfection' X Near-white seedling out of 'Mrs. Bromley') Perfectly rounded head of bloom. Stout 15" (38mm) stem. Color is brilliant coral pink. Slightly paler tips, little ruffling, doesn't matter. Real elegance, here. Stamens are shocking fluorescent orange-pink. Effect is brilliance and classic perfection.

'Diablo'—('Ben Hills' X 'Classical Jazz') Miniature. Intense black-red. Ruffled flowers on a 13" (33mm) stem. Stem is slender, but stands tall and straight like its pollen parent.

'Regency'—('Vestal' X Unknown) Very classy mid-sized white. Lovely head of bloom, has great shape. Size and color very good.

'High Tech'—(Parentage unknown) Glorious copper, smoky. Extremely tall, straight stem. Big head, ten large flowers, well proportioned.

'Premier Pink'—(G64-21, Menninger seedling X E54-166, Exbury seedling) Moderately tall. Stout-stemmed. Very pretty pink. Perfect head, 14 florets. Color is outstanding, a very satisfying pink. If it has flaws, they escape me.

'Boom Time'—('Cupid' X 'Sea Shell') Big smoky salmon, eleven florets in a perfect head. Very tall, stout stem; lots of class.

'The Empress'—('Cupid' X 'Sea Shell') Sister seedling to 'Boom Time', but very different. Color is palest pink; excellent.

'Invictus'—(G54-261, Menninger seedling X G?-65, Menninger seedling) Miniature. Intense black-red, ruffled flowers. Slender 12" (31mm) stem.

'Smoke Dance'—(Rose Red seedling from Tony Norris X 'Ben Hills') Ruffled, fluted edges on copper-brown petals. Bright copper strip through center. Extremely beautiful, ten plus flowers on a 16" (41mm) stem. Muted color; unusual and very beautiful. Lots of glitter dusting.

'Memories'—(G54-317, Menninger seedling X 'Blue Ruffles') Ruffled, unusual blue. Nine to 10 florets; wonderful head shape, well-proportioned. Mid-size stem, truly beautiful.

'Regal I'—('Solent Swan' X E54-111, Exbury seedling) Blush pink, nearly white. Beautiful shape, beautiful size, exquisite color, soft; invites touching.

Two new seedlings which bloomed for the first time in 1984 are: 77-72/Pink 84-23 (G54-39, Pink Menninger seedling X G66-5, White Menninger seedling), a "lovely ruffled pink with red star in throat, tall stem, beautiful shape"; and, 78-4/Rose 84-25 (G54-358, Menninger seedling X 'Rushmere Star'), an "outstanding later, darker version of its pollen parent."

Some other seedlings which are still being tested for perennial performances are: **'Star'**, **'Wanderlust'**, **'Rajee'**, **'Orange Frills'**, **'Sugar Plum'**, **'High Barbary'**, and **'Terpsichore'**; all of them are unique and beautiful. But will they stand the test of time?

Among the many seedlings given to me by Emma Menninger when we repotted the GREENOAKS Nerines, were three which have stood time's test. When I look forward year after year to seeing a plant bloom, there comes a point when I say to myself, "Anything this good ought to have a name." As Emma is no longer among us to officiate at the baptisms, I have named them in her stead.

'Perfection'—(Parentage unknown) One of Emma Menninger's best. Lovely bi-color, sparkling pink with salmon midrib. Heavy texture. Slight ruffling. Tall stem. Good breeder both ways, transmits its good qualities to its offspring.

'Alderon'—(Parentage unknown) Opens a beautiful shade of cerise-red with a nearly white throat. Wonderful bi-color, ruffled segments. Stem 12" (28mm) plus; straight. Segments not wide, but this one commands attention.



Nerine: 5-‘High Tech’. 6-‘Regal I’. 7-un-named seedling 77-72, 8-un-named seedling 78-4



Figure 9. *Nerine* 'High Barbery'

Figure 10. *Nerine* 'Discovery'



'Discovery'—(Parentage unknown) Lovely mid-rose color. Stout stems. People notice this one. Good flower size and nice, wide segments.

I have been working with Nerines for less than fifteen years. That's a short time, only about three generations; but, ah, the memories . . .

With luck, I have perhaps another forty years of hybridizing work left in me. With hard work and a lot of luck, there should be a few good cultivars tucked in among those years. Who knows, there may even be two or three outstanding seedlings out there waiting for me to find them. If so, they'll identify themselves. As I've said, quality shows. Even when it's marching in the ranks.

A NEW GENUS AND A NEW SPECIES FROM BOLIVIA

Reprinted and translated from *Fontqueria* 4:33-36 (1983):

Androstephanos tarijensis* Fernandez Casas & Lara, *gen. et sp. nov.

[LATIN] "From all other Amaryllidaceae our new genus is peculiar by its flat corona, which above the united filaments, consists of an annulus (ring), showing the filaments free below (cf. figure). The species is hysteranthus, i.e. leaves following the flowers, with a long collar or neck, up to 20cm long and 2cm broad; the scape is 20cm tall; the larger part of the spathe is compounded into 2 slender segments (laciniae) up to 4cm long; with peduncles 3-5cm long; and with each red petal 25-28mm long. The holotype is conserved in the herbarium of the Royal Botanical Garden of Madrid. Isotypes are at Geneva and New York.

[SPANISH] "We have taken the genus name from the Greek for stamens and corona. This refers to the corona's being formed by the union of the upper portion of the stamens. We are unacquainted with the leaves and bulb of this plant, as well as any cytological characteristics. Fortunately, since several specimens are in cultivation in Cochabamba, Bolivia, we will obtain in the near future material for a better understanding of this interesting species of the Bolivian flora.



Figure 1. *Androstephanos tarijensis* Fernandez Casas & Lara (Holotype, Lara #1842, MA). 1) Neck of the bulb. 2) Floral scape. 3) Flower without peduncle. 4) Insertion of the stamen filaments with the tepals. 5) Details of the corona and tepal.

NERINES IN THE U.S.A.

CHARLES HARDMAN
BALDWIN PARK, CALIFORNIA, USA

The first large *Nerine* collection in the United States of America—based on the species *N. sarniensis* and its hybrids—was built during the 1930s by Mr. Frank Reinelt, a plant hybridizer who maintained his headquarters at Capitola, California.

The existing records concerning the beginning of that collection do not include any specific dates, so we cannot state with certainty even the year which marked that important horticultural event.

The records do show, however, that the original bulbs were purchased from the English firm of Barr & Sons. A later, 1941, catalog from the Barr nursery lists many of the older favorite cultivars: 'Aurora', 'Beacon', 'Hera', 'Lucifer', 'Manselli', 'Nymph', and 'Siegelinde' were all included, as were the species *N. bowdenii*, *N. plantii* (sic), *N. fothergillii major* (sic), and four varieties of *N. sarniensis*: variety *sarniensis*, var. *corusca major*, var. *insignis*, and 'Rose Queen'. It is safe to assume that Mr. Reinelt would have acquired most, if not all, of the varieties listed, as he was a skilled hybridizer and he would have wanted to obtain a genetic base as broad as possible for his future hybridizing work.

By 1939, the collection had grown to some 6,000 bulbs. At this point, Mr. Reinelt determined that he would concentrate his hybridizing efforts on other genera. As a result, he sold the *Nerine* bulbs to Dr. J. K. Reticker, and the Messrs. G. A. Bauman and John R. Bauman, owners and managers of the Palos Verdes Begonia Farm in Palos Verdes, California.

Mr. Reinelt had done some preliminary hybridizing work before the collection was sold, and the resultant seedlings were included in the sale. Hybridizing on a large scale was undertaken immediately by the new owners, and within ten years many thousands of seedlings were being grown, while sales of potted *Nerines* were increasing yearly.

A Palos Verdes Begonia Farm brochure, circa 1945, records that over 40,000 bulbs were being grown at that time, a figure which included old cultivars, new cultivars, and seedlings.

These bulbs were grown in open acreage a short distance from the ocean. Here, the plants thrived. Ocean breezes tempered hot summer days and cold winter nights. There were no frosts, no baking sunlight.

A note in that same circa 1945 brochure states: "Nerines have no diseases or pests so far known." In an interview with Mr. John Bauman during the summer of 1972, he confirmed to me that during his years of

work with *Nerines* he had experienced no problems with diseases, insects, or pests. This is a remarkable testimony to the *Nerine*, and certainly must be a reflection upon the growing abilities of the Begonia Farm growers as well. Apparently, the viruses which have become such a curse to certain modern collections posed no problems for the Reticker/Bauman collection.

Hand-written on a piece of yellowed paper from the Begonia Farm files are descriptions of several seedlings which appeared during those years of intensive development. These reveal a few rare glimpses of the directions the work was taking. "Number 53- Light lavender shot with silver sheen. Long, wavy, recurving petals. Pale pink bar down center; Number 51- Most beautiful, pale, waxy pink, large flower," (but) "compact, wavy petals, dark pink center; Number 47- Variegated. Pink tips, white center, waxy, recurving petals." And my two favorites: "Number 54- Copper. Large flowers. Wide scarlet bar. Wavy, recurving petals; Number 48- Rust, gold dusted, large flower, recurving petals."

Alas! It is not known whether these seedlings still exist. Remnants of the original collection were being tended, through 1972, by the parents of Mr. John Bauman. Even then the bulbs were no longer being propagated for sale.

The Reticker/Bauman *Nerine* collection expanded from 1939 to 1950, when a decision was made to shift emphasis onto the production of Begonias and general nursery items. The town of Palos Verdes was growing, along with all the communities of Southern California, and that growth created a demand for landscape items. Hybridizing and growing efforts were directed to landscape material, and the *Nerines* were sold off gradually until only the core of the collection remained. It is this core group which was still being grown in 1972 by Mr. Bauman's parents. This writer has no current knowledge of these plants.

During the same year that the Bauman *Nerine* collection was being phased out, a second American collection was just beginning. The Menninger *Nerine* collection at "GREENOAKS" in Arcadia, California, was initiated by a visit to GREENOAKS by Mr. Peter Barber, agent and manager for the Rothschild's Exbury estate in England. Mr. Barber was in the United States attending to some business matters during 1950, when he paid a visit to Mr. and Mrs. Elmore Menninger, owners of GREENOAKS.

At that time, Mr. and Mrs. Menninger were deeply involved in the work of collecting species and stud hybrid *Cymbidiums*, and hybridizing them. They had recently purchased from Exbury a plant of the famous tetraploid *Cymbidium* 'Rosanna Pinkie'.

Mrs. Menninger had already grown a few *Nerine* bulbs acquired from that indomitable guiding light of South African bulbs, the late Kate Stan-

ford. These bulbs had been planted directly in the soil without underground screen-guards or overhead protection. Mrs. Menninger felt that gophers ate most of these bulbs, but it is just as likely that the still-talked-about killer frost of 1949 was the force which actually carried them away. (Older plant growers in the area tell me that the temperature never got above 27°F for three days, an almost unheard-of situation.) By 1950, only a few of these *Nerine* bulbs were still alive.

At GREENOAKS, located 30 miles from the ocean in Southern California's San Gabriel Valley, an entirely different climate prevails from that found along the coast. Summer days are often blazing hot. And light to moderate frosts are common during the three-month period extending from mid-December through mid-February. A genuine hard freeze occurs only every 20 years or so. But when one does come along, the tropicals perish overnight, and our famous *Geranium* hedges are reduced to *Geranium* stumps. At the time of Mr. Barber's visit in 1950, existing glasshouse space at GREENOAKS was taken up by *Cymbidium* culture, which necessitated carrying on any further work out-of-doors. It was not known if techniques and growing conditions could be developed whereby *Nerines* would grow successfully in the open under such conditions.

Considering the problems and risks, Mrs. Menninger was certain that her husband would say "No" when Mr. Barber quoted a proposed selling price for "a bulb of every cultivar in the Exbury collection." Instead, Mr. Menninger said "Yes", and over the next five years the bulbs were shipped, a few at a time, as offsets of each cultivar then in the collection, and new Exbury seedlings developed until the negotiation date, became available.

Numerous correspondence was exchanged. Questions on origins of cultivars, cultivation techniques, and information of every description relevant to *Nerines* and the sale were discussed by mail for the entire five-year period during which the bulbs were being shipped. Eventually, most of the Exbury varieties were received. But not the cultivar 'Alice'. 'Alice', one of the most famous of all the Exbury *Nerines*, had already vanished. Even Mr. Barber could not tell the Menningers what had happened to it. One bulb apparently had gone to Australia, there, through a series of misfortunes, to end up on a trash heap. The other bulb(s) was stolen. Or so the story goes.

The GREENOAKS *Nerines* were grown in a soil mix consisting of approximately equal parts of the coarse granite sand common to the Arcadia, California area surrounding the nursery, and oak leaf mold, also common to the area. Cool, late-summer nights, wet winters and dry summers are also features of this part of Southern California. The combination seemed to work, for the bulbs, grown outside in pots and fertilized with commercial

fertilizer only infrequently, grew and multiplied with abandon.

Occasionally, a frost would cut back the leaves, or even kill a few bulbs (the intense heat of summer could achieve this latter feat, as well), but the GREENOAKS staff developed light, protective devices which largely eliminated these problems.

There are advantages in being able to grow *Nerines* in the open. For one, space is less of a problem: seedlings can be grown in abundance. From the first, Emma Menninger made it a point to produce and grow to flowering size thousands of seedlings. From these were selected the GREENOAKS cultivars 'Stormy Sunset', 'Redwood', 'La Mousmee', 'Blue Rose', 'Countdown', 'Coral Treasure' and 'Ambrosia'. Others were 'Charm', 'Fireball', 'Garnet', 'Roundelay', 'Hermitage' and the haunting 'Ashes of Roses'. One of Emma Menninger's last named *Nerine* hybrids is the beautiful 'Blue Ruffles'. This opens its flowers to reveal a lovely shade of lavender-blue. It has none of the graininess characteristic of so many in this color range.

Emma Menninger worked with *Nerines* for twenty-five years. Although the white cultivars were not her favorites—she was partial to the darker-colored cultivars—Mrs. Menninger concentrated on "the whites", as she called them, because, in her words, "they needed work." She never achieved her dream of creating the classical white *Nerine*, but the ground-work Emma Menninger prepared is certain to help others in their efforts towards this goal.

My own collection of *Nerines* was begun in 1970 with the few bulbs I was able to purchase from Borde Hill in England. Then, in 1973, I was fortunate in being able to work out an agreement with Mrs. Menninger whereby I acquired at least one bulb or offset of every cultivar and seedling in the Menninger collection. The resultant gene pool greatly accelerated my efforts with the genus.

Further acquisitions of bulbs from the collections of several growers worldwide, including Dr. Shuichi Hirao of Japan, Mr. R. E. Harrison of New Zealand, and Mr. Tony Norris of England, have expanded the genetic pool available to my hybridizing work. As a result, each autumn I discover newly-blooming seedlings with improvements which surpass even my strict expectancies.

My personal goals in hybridizing *Nerines* include the optimum white, taller- and sturdier-stemmed cut flower cultivars and an expanded color range. I would like to see some clear, spectrum reds which don't discolor with age. Discoloring—either darkening or fading of the flowers—seems to be a significant problem with many *Nerine* cultivars. Part of my work is aimed at helping to eliminate this problem in my own future cultivars.

I am also working with the whites in an outbreeding program, which will be followed by a line-breeding program, in an effort to enhance the qualities of this superb section. Results thus far have been quite satisfying.

In addition, I am finding a few miniatures appearing among my seedlings. These little flowers have a grace and charm all their own. I will be making some additional crosses each year among these miniature seedlings.

One final note concerning my personal efforts at *Nerine* breeding concerns phototropism of the flower stems. This seems to be a problem wherever days are sunny and bright during the flowering season. The flower buds like to point toward the sun. Here, in Southern California, this tendency can be a problem. September, October and November produce some of our sunniest days.

However, a few cultivars and seedlings show little or none of this tendency to reach toward the sun. My breeding efforts are concentrated on stabilizing this desirable "straight and stately" characteristic into my seedling lines.

Here and there, a few *Nerine* collections have been started in the past in the United States, but I have little information, concerning these collections. Mr. Cecil Houdyshel, for instance, once grew thousands of bulbs at his location in La Verne, California and Mr. L. S. Hannibal had a small *Nerine* collection years ago and was making crosses with them. Mr. Hannibal's work with *Nerines* was set aside in order to pursue work with other genera.

Longwood Gardens, in Kennett Square, Pennsylvania, also had a small collection of *Nerines* in the 1960s. This collection included less than a dozen cultivars. I do not know whether any hybridizing work was attempted.

The GREENOAKS *Nerine* bulbs were shared by the Los Angeles State and County Arboretum at Arcadia, California, and by the Huntington Botanical Gardens in San Marino, California, when Mrs. Emma Menninger disposed of the GREENOAKS *Nerine* collection. It is not likely that either establishment has plans for continuing the hybridizing work.

Dr. Hamilton P. Traub grew a few *Nerines*, and introduced at least two hybrids: *N. X traubianthe*, a cross between *N. filifolia* and a *N. sarniensis* hybrid, and a hybrid of unknown parentage which he named 'Scarlet O'Hara'.

Before her sudden tragic death in 1983, Mrs. Marcia C. Wilson had begun growing some *Nerine* bulbs at her gardens in Brownsville, Texas. Marcia was especially excited to learn from her preliminary plantings out-of-doors in Brownsville that certain *Nerine sarniensis* hybrids would take

considerable cold. In one of her last letters to me, she wrote that her bulbs were doing well planted outside, in spite of the cold snaps common to her area. Her letters suggested that the bulbs were planted in a sheltered spot, and that some minimal protection had been provided during the coldest weather.

There have been other American *Nerine* growers over the years, and even a few who have tried their chances with hybridizing, but about the work of Mr. E. O. Orpet, Mr. J. N. Giridlian, Mr. H. N. Moldenke and others, past and present, I have only the barest bones of information.

There are three U. S. *Nerine* collections, other than my own, with which I am familiar, however. All three are active, enlarging collections, and all three growers are working with hybridizing. These are the *Nerine* collections, all in California, of Mr. Jack Catlan of La Cañada, Mr. Ed Zinkowski of Rosemead and Mr. Fred Meyer of Escondido.

Mr. Catlan has a collection of *Nerines* which originated from several sources, including some bulbs from GREENOAKS. Currently, Jack has quite a few seedlings growing on to maturity. These should begin producing their first crop of blooms within a few years.

Mr. Zinkowski's *Nerine* collection is currently expanding at a rapid pace. Ed is growing about 1,500 new seedlings each year from crosses which incorporate the best of the older English cultivars with the newer New Zealand and American cultivars. Some of the seedlings are coming into bloom each year, and the results are most encouraging. One which bloomed for the first time in 1983 produced a massive, perfectly ball-shaped head of medium red-colored flowers; a spectacular sight.

Also blooming for the first time in 1983 was an improved white, which exhibited wonderful tepal substance, and showed exciting improvement in keeping quality and vigor.

Mr. Zinkowski has begun working with summer-growing species, crossing them with pollen from the *N. sarniensis* types. His goals are to extend the color range and to improve the shape of the flower segments and the flower heads of these hybrids over the current summer-growing species.

Another American collection of *Nerines* which is proving exciting is that of Mr. Fred Meyer. Mr. Meyer travels worldwide in relation to his cut-flower business, and he has managed to acquire a wonderful group of improved cultivars of *Nerine* species from growers in several parts of the world. He has also imported some of the impressive new hybrids from England and Holland. Fred's growing grounds are extensive and frost-free, so most of his bulbs are out in the open.

Mr. Meyer has experimented extensively with growing media. As a result, he now raises many of his finest *Nerines* and *Nerine-Brunsvigia*

hybrids in a mix which he starts by making a pre-mix of 50% gravel and 50% lava chunks. To this mix is added 5% (by volume) peat. Mild fertilizing with each watering results in almost hydroponic growing conditions. The blooms, most of which are sold on the cut flower market, are magnificent. And the bulbs produced by this growing method are gargantuan, with root systems from three to five times larger than those produced by the standard cultural techniques recommended for *Nerines*. Gravel/lava culture has proven to be a wonderful system for growing *Nerines*, and Mr. Meyer is to be commended for his pioneering work with this system.

Currently, Mr. Meyer's *Nerine* collection is producing seedlings aimed at the cut-flower market. Much of the hybridizing work he is doing involves intergeneric crosses between *Nerine* and *Brunsvigia*.

Any article written about *Nerines* in the United States is going to be incomplete. This article is no exception. There is simply too much unknown.

Of that information which is known and certain, even it is not always easy to convey. How does one tell, for instance, of the struggles early growers encountered in building their collections of *Nerines*? Even today these beautiful flowers are considered uncommon.

And producing new *Nerine* hybrids requires space, time and patience, not to mention that great lubricant for so much of mankind's cultural progress: money.

But the early American *Nerine* growers and hybridizers left us with a good base upon which to build, so the future of *Nerines* in the U.S.A. looks exceptionally bright. New growers, eager for something different, keep trying these floral jewels. And new hybridizers, recognizing the exciting potential of this largely-untapped genus, are increasingly eager to spend the time and make the efforts required to create new cultivars.

To Frank Reinelt, J. K. Reticker, G. A. Bauman and John A. Bauman, Emma Menninger and all the others who pioneered *Nerine* work here in the United States, thanks for passing on the torch to us, the current generation of *Nerine* growers and hybridizers. We hope our work would have made you proud.

HYMENOCALLIS FROM SEED

GARRY NEWTON
MEDICINE HAT, ALBERTA, CANADA

The seeds of *Hymenocallis* are typically large, green, oval and smooth, though, as might be expected in such a large genus, considerable variation in these characteristics occurs between species. Size may range from 1.0 x 1.0cm to 2.5 x 3.5cm; color from light yellow-green to dark blue-green; shape from subspherical to irregularly wedge-shaped; and texture from perfectly smooth to somewhat leathery. When several develop in a single capsule, they tend to be faceted towards the hilum by pressure from adjacent developing seeds. Germination frequently occurs while the seeds are still attached to the mother plant.

Seeds are best planted in individual plastic cells or small pots. If they are half-buried in a light, sandy compost and exposed to strong light, they usually germinate within a few to several weeks, though in my experience, in nearly every batch there are a few which do not germinate for several months.

Being a newcomer to raising amaryllids, I was interested in monitoring the development of young seedlings, especially in observing how a bulb is formed, something I had not seen before. Since they are quite robust plants, even in the early stages, seedlings can be removed periodically from their pots for examination without any adverse effects, though care must be taken not to damage the radicle.

The usual course of development is for a radicle to penetrate the seed wall from a point near the hilum, though it may appear at virtually any place. If the radicle is bruised, broken or allowed to dry out, development ceases and the seed dies. For this reason, seeds sent by mail should be packed in small bags containing a cushioning material such as moistened vermiculite, since germination often occurs during transit. When the radicle has extended two or three centimeters, linear growth ceases and the radicle begins to expand, quickly attaining the dimensions of a small but perfectly formed bulb. It is at this stage that the bulk of the seed's nutrients are transferred to the newly formed bulb, and the seed, exhausted, collapses and decays. The small bulb, now independent, continues its growth. Close examination reveals the existence of a minute basal plate, from which relatively thick, fleshy roots soon develop; and from a point near the former attachment to the seed the cotyledon sheath appears, followed by the first true leaf.

These casual comments are based on direct observations and drawings. My botanical explanation may be incorrect, but it looks as though the radicle, in its very early stages, possesses a central axis of meristematic tissue which differentiates into growing points: the very tip of the radicle, and a point roughly halfway between the tip and the seed. The former is responsible for initiating the basal plate and root system; the latter, for the future bulb scales and leaves.

In most deciduous species, the onset of dormancy is indicated by the withering of the leaves; however, several members of the genus do not produce a leaf during their first growth period. This is true of the subgenus *Ismene* and of a group of species in the *Mexicana* Alliance closely related to *H. choretis*. When the newly formed bulb has reached a certain size, the seed decays, and there is no evidence above the soil that the seed has even germinated. Herbert cautioned his readers against discarding a seemingly unsuccessful pot too hastily, as it might contain a large and healthy young bulb, lack of foliage notwithstanding.

Several species of *Hymenocallis* are able to produce more than one plant from a single seed. This mode of development is particularly interesting to follow, and I was fascinated to observe its occurrence fairly frequently in *H. howardii*, *H. glauca*, *H. sonorensis* and *H. maximilliani*. Eager to learn more about this phenomenon, I consulted back issues of *Plant Life* and *Herbertia*, but located only a single reference to it. In 1966 Dr. Traub reported his experience with *H. mexicana*, seeds of which had produced two young bulbs each. According to Dr. Traub, this was the first occasion polyembryony had been reported among the Amaryllidaceae. Subsequent year books revealed no other mention, though undoubtedly it has been observed widely and frequently.

Of the dozen species of *Hymenocallis* I've raised from seed, polyembryony has occurred most strikingly in *H. chiapasiana* of the *Mexicana* Alliance. This species routinely produced two or three seedlings per seed and in one instance five. In the latter case, the newly formed bulbs were entirely normal in shape, though a trifle smaller than average, and all subsequently grew well. Occasionally, minute bulbs are to be found, generally growing very close to the seed, and though they may perform adequately at first, they usually fail to persist into their second season. In the case of the seed which produced five young plants, in two of these dwarfed structures were present, each about 0.3cm in diameter, and though they have not flourished, nor even grown, neither have they decayed, so it might be possible eventually to obtain seven bulbs from a single seed. Usually, each plant owes its existence to a single radicle. But some radicles are able to produce more than one plant. Quite frequently, late-developing

radicles produce plants within the seed itself, eventually splitting it. The latter are usually crescent shaped and rather smaller than the norm, but appear just as healthy as the others.

Polyembryony occurs widely among the gymnosperms, especially in pines, where a single zygote routinely divides into as many as eight embryos, all but one of which, as a rule, subsequently deteriorate. In the flowering plants, additional embryos can arise from nucellar buds, from synergids, or antipodal cells, all without fertilization. This has been noted particularly in *Cirrus* and *Funkia* (*Hosta*). It can also result from cleavage of the egg. The immediate cause has been attributed to genetic effects, the presence of hormones released from dying cells, and to the effects of hybridization. How it arises in some Mexican *Hymenocallis* so frequently I've no idea, but the subject is very interesting and ought to be pursued. The few references I've consulted make only passing mention of the phenomenon, and none at all of its occurrence in the Amaryllidaceae. I've observed multiple bulb formation also in *Calostemma purpureum*, which, together with *Hymenocallis*, has been assigned to the Tribe *Euchareae*.



Figure 1. *Zephyranthes atamasco* var. *atamasco*. FLAS Herbarium photo.

NOTES ON FLORIDA ZEPHYRANTHES

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In the course of preparing a treatment of the Amaryllidaceae for a *Flora of Florida*, the question arose of how best to deal with two of the three southeastern United States taxa of *Zephyranthes* Herb. *Zephyranthes atamasco* (L.) Herb. (Figures 1-2) and *Z. treatiae* S. Wats. (Figures 3-4) are no strangers to taxonomic controversy. In regional floristic treatments, these taxa have either been maintained as distinct species (Small, 1933; Godfrey and Wooten, 1979) or else considered synonymous as *Z. atamasco* (Radford et al., 1964; Wunderlin, 1983).

It has chiefly been on the basis of foliage characters that these erstwhile species have been separated. *Zephyranthes atamasco* typically produces wide, slightly concave, glossy leaves with sharp margins, while *Z. treatiae* is typified by dull, narrow, blunt-edged leaves. Wide-ranging *Z. atamasco* (Virginia to Florida) inhabits low-lying, often shaded, sites in wet, often swampy hardwood forests, while the more restricted *Z. treatiae* (Florida and sparingly north to South Carolina) is found in pine flatwoods and along wet roadsides, usually in more open situations. Floral characteristics are much less reliable; the perianth limb segments of *Z. atamasco* are usually broader and more erect than those of *Z. treatiae* which, in addition to being narrower and spreading more widely, are reflexed near the apices. Both have somatic chromosome numbers of $2n = 24$ and very similar karyotypes (Flory, 1940; Flagg, 1961). Hume (1935a & b) cited profound differences in growth habit as well, describing *Z. atamasco* as strongly stoloniferous, and *Z. treatiae* as occurring most commonly as single individuals.

Vociferous adherents of specific status for both taxa claim that the morphological discontinuities between them are ironclad, and that their ecological boundaries further qualify them as distinct species. Flagg (1961) reviews the subject in detail, and concludes that floral characteristics do not reliably distinguish these taxa. For better or worse, compilers of roadside wildflower guides seem to artfully choose photographs of each plant that represent a cut-and-dry picture of floral differences. As Flagg (1961) points out and I have observed in nature, both may vary considerably in curvature and width of the perianth segments.



Figure 2. *Zephyranthes atamasco* var. *atamasco* in its boggy, hardwood habitat; St. Johns County, Florida. FLAS Herbarium photo.



Figure 3. *Zephyranthes atamasco* var. *treatiae*, Alachua County, Florida. FLAS Herbarium photo



Figure 4. *Zephyranthes atamasco* var. *treatiae* in its usual habitat of pine flatwood. Madison County, Florida. FLAS Herbarium photo.

Distributions of these taxa overlap near the Florida-Georgia border (Flagg, 1961), but there are no reports of hybridization and introgression. Yet habitat differences may not be as clear cut as imagined. *Zephyranthes treatiae* may be found at times in the wet, hardwood habitat considered the exclusive province of *Z. atamasco* (Flagg, 1961).

The clumping habit of *Z. atamasco* contrasted with the usually solitary nature of bulbs of *Z. treatiae* may be an artifact of habitat differences. The pine flatwoods that usually host *Z. treatiae* are subject to frequent fires. Destruction of the leaves in this manner may inhibit the formation of offset bulbs, the production of which, in part, is probably dependent on translocated photosynthesis from the leaves.

This leaves only the aforementioned foliage characteristics to consider. Here, too, Flagg (1961) reports a collection made in Marianna State Park, Florida, determined by himself, Drs. Walter S. Flory and R. K. Godfrey as *Z. atamasco* on the basis of its leaf morphology, which, in cultivation, produced leaves of the *Z. treatiae* type. Bulbs of *Z. treatiae* that I have cultivated have been observed to occasionally produce a leaf approaching "typical" *Z. atamasco* in form.

In conclusion, these taxa seem to present a tidy argument for their treatment as varieties of a single species, *Z. atamasco*. *Zephyranthes atamasco* var. *treatiae* (S. Wats.) Meerow would appear to be a relatively stable Florida segregate of the species, ecologically specialized, that has migrated northwards (and may be continuing to do so). Detailed garden experiments and gel electrophoretic investigations of these taxa would be very illuminating.

The third Florida taxon, *Z. simpsonii* Chapm. ($2n = 48$, Flory, 1940; Figures 5-6), may well be a tetraploid derivative of *Z. atamasco* var. *treatiae*. It can occur sympatrically with the former, in which case triploid block presumably prevents successful hybridization. It is usually distinguished by its less spreading perianth limb, shorter gynoeceium, and a more regular suffusion of pink in the perianth. Leaf morphology is as for *Z. atamasco* var. *treatiae*.

Like the North American species of *Hymenocallis* Salisb., whose complex biological realities defy an exclusively alpha-taxonomic approach, the Florida *Zephyranthes* story suggests a recent and still active evolutionary history in the United States.



Figure 5. *Zephyranthes simpsonii*; Flagler County, Florida. Note the solitary *Z. atamasco* var. *treatiae* at the extreme right. FLAS Herbarium photo.



Figure 6. *Zephyranthes simpsonii* in pasture; Manatee County, Florida, not far from the type locality. ELAS Herbarium photo.

Zephyranthes atamasco* var. *treatiae* (S. Wats.) Meerow, **comb. et stat. nov.*

Basonym: *Zephyranthes Treatiae* S. Watson, **Proc. Am. Acad.** 14:300 1879.

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OUTSTANDING HYBRIDIZATION AND OTHER ACHIEVEMENTS IN AMARYLLIDS

MARCIA C. WILSON

(In correspondence to Dr. T.M. Howard on 5 August 1983, the late Mrs. Wilson reviewed the special, outstanding achievements in amaryllids over the past 50 years. The following is an adaptation of her letter, ed.)

Zephyranthes

Zephyranthes X ruthiae cv. 'Ruth Page' (*Z. rosea* X *Z. citrina*)

This single hybrid by Dr. Howard is not in itself as significant as that it serves as a stepping stone to a whole line of multi-colored and various-sized, everblooming hybrids. The cultivar is somewhat similar to *Z. grandiflora* in color, but slightly darker, slightly smaller, equally hardy, and very fertile. It was the forerunner of a large race of hybrids of various colors and forms, many of which were as hardy as *Z. citrina* and the native Texan members of subgenus *Cooperia*.

Z. X bi-puerto-rosea

Although Mrs. Clint (Mrs. Wilson's mother) had the first *Z. bifolia* hybrids, 'Padre Cicero' gave the first everblooming, fertile line of hybrids. This triple species cross is an interesting complex hybrid group developed by Padre Cicero in the Dominican Republic by intercrossing *Z. bifolia* with *Z. rosea* and *Z. puertoricensis*. Many of these shared the rich scarlet color of *Z. bifolia*, but with much added vigor and some degree of fertility. These hybrids seem to be just an extra bit hardier too, but are really too tender to winter out of doors except in frost-free areas.

Hymenocallis

Hymenocallis X "Bundrantii" (unpublished) (*H. traubii* X *H. narcissifolia*) (Bundrant)

This is a primary class cross, made by Luther Bundrant, which needs to be named. To discard all the subsequent crosses by others is not wise since it presupposes that the cross will never be repeated. I have not bloomed 'Excelsior', but I doubt that it is different enough to cause throwing the other hybrid progeny out. Since 'Excelsior' will not be on the market for awhile, certainly not in great numbers, I think the cross should be named *H. X bundrantii*. These plants have a good degree of cold hardiness and serve as fine prospects for container culture.

H. traubii X *H. narcissifolia* (Howard)

This cross by Dr. Howard was added to Mrs. Wilson's list in a later letter. She considered it equal to the 'Excelsior' hybrid line. It is similar to Bundrant's 'Excelsior', but is a larger plant in bulb and leaf characters. The flowers are only slightly smaller. This should be one of the hardiest hybrids known. The flower buds open a yellowish color with yellow and green centers, but the flowers fade quickly to white. 'Buccaneer' is the clonal selection, with *Ismene*-like form.

Hippeastrum

Leonard Doran's 1 & 2 R5 Hybrids

These are generated from extra-petaloid (double) *H. lapacense* X Dutch hybrid stocks. The hybrids are extremely vigorous and beautiful. They have double perianths which exceed in size any other "doubles" of this type.

Discovery of *H. evansiae*

This find has led to a keen interest, notably by Cothran, in the yellow color in hybridization. The development of miniature Hippeastrums and increased general interest in diploids has also been stimulated by this discovery.

Crinum

C. 'Carnival'

This development by Dr. Howard led the pack in exploiting the results of multi-crosses, i.e. species X multi-hybrids and hybrids X hybrids.

Sprekelia

Hybrids involving the clones known as 'Orient Red', 'Inca Queen' from Peru, and 'Superba'

These crosses by Kitty Clint and Dr. Howard brought about recognition of 'Orient Red' as the basis for robust and everblooming hybrids. The Peruvian 'Inca Queen' is a very dark-red with a "flat face" form. 'Orient Red' hybrids with 'Inca Queen' and others are superior in being more robust, everblooming and in having large flowers. They often are of superior form and have wider petals.

X *Sprekanthus cagei*

This bigeneric hybrid made by Cage, between *Sprekelia formosissima* and *Habranthus robustus* has smaller flowers of *Sprekelia* and growth habit of *Habranthus*. The good, red color is also a winning attribute.

Nerine

The commercialization of Nerine hybrids and species by Anthony "Tony" Norris in England has helped spread the cultivation of these South African plants.

Crinum Bigenerics

L.S. "Les" Hannibal has been most active in promoting these crosses between the South African *Amaryllis belladonna* and Crinums. The hybrids are referred to as X *Amacrinum*.

Polianthes / Manfreda

Work on hybrids in these genera is lagging, but Bundrant's hybrids demonstrate their promise. Aside from being novel, they are colorful and sometimes fragrant. The introduction of the tri-color *Polianthes howardii* is very exciting but needs a greater distribution to growers. Named hybrids in *Polianthes* include:

P. X blissii (*P. geminiflora* X *P. tuberosa*)

P. X bundrantii (*P. tuberosa* X *P. howardii*)

P. X 'Sunset' (*P. tuberosa* X *P. species*, yellow-and-red)

Future Activities***Crinum***

C. flaccidum should play a major role in development of hybrid Crinums because of its yellow color. It is also a cold-hardy, miniature species. The development of miniature Crinums has yet to proceed with any determination.

Hippeastrum

Development of fertile yellow hybrids, green-flowered *H. calyptratum* hybrids and miniatures of all kinds for garden and window sill will stimulate greater interest in these plants. Double perianth hybrids will be popular.

MEXICAN FIELD TRIP—1984

Stalking the **Polianthes** of Mexico

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The purpose of our 1984 trip into Mexico was mainly to collect *Polianthes*, many of which are becoming endangered. These colorful allies of the garden tuberoses, many of which are fragrant, are in need of propagation and distribution as garden material to preserve them now that their habitats are being destroyed. Also, there is keen interest in them as a source for potential garden hybrids incorporating color, fragrance and ease of culture.

I was accompanied on this trip by Dylan Hannon of Santa Barbara, California, and Jane Kersey of San Antonio, Texas. Dylan is a college student and intensely interested in not only bulb life, but just about all the plants one can consider. He was a walking encyclopedia of memorized information and seemed to know the name of almost every tree, forb, and shrub that we came across. But he was a novice for this type of trip and each day was a new adventure. Jane, on the other hand, was a seasoned veteran, having long ago adjusted to traveling in a foreign country. Thus there was a good balance between seasoned experience on the one hand and the excitement of new discovery on the other. Our van's interior was charged with the electricity and volatility of the combination. There were few dull moments.

Aside from our main quest for *Polianthes*, we were also seeking its allies *Manfreda* and *Prochnyanthes*, plus the usual other things of interest: *Milla*, *Bessera*, *Tigridia*, *Cypella*, *Nemastylis*, *Zephyranthes*, *Allium*, *Sprekelia*, *Hymenocallis*, *Crinum*, *Begonia*, *Anthericum*, *Tradescantia*, *Calochortus*—you name it. The litany of our interests, at first, tended to slow us down too much in our collecting, since we were on a tight schedule and had about 5,000 miles of driving in a little over two weeks. The trip was rather well plotted so that I knew where we would be each day, how many miles we would drive, what we expected to collect, where we would eat, and spend the night. Unexpected events caused me to recompute several running changes in order to maintain the rigorous schedule. Such a trip has a beginning, a middle, and an end, and it must be orderly and disciplined. Any major changes can alter the entire goal of the trip and make it less than a success. As it turned out, by some careful alterations, we did achieve our goals.

We left San Antonio, Texas on a Friday afternoon, July 27, 1984, and drove westward to Presidio, where we would spend the night before



Figure 1. The Rio Grande—International Boundary. Jane Kersey photo.

crossing into Mexico the next day at Ojinaga, Chihuahua, in the Big Bend country. Our first delay came the next morning when I made a wrong turn in Ojinaga, and lost several hours before returning to the town and getting back on the right road. It was my fault, but the road signs and markers leave a lot to be desired and it is very easy, believe me, to make a wrong turn if the signs are not clear. That loss of time alone cost us almost a half day of driving, and forced us to begin making adjustments in our schedule that we really were not ready to do. This is part of the risk when travelling in unfamiliar territory.

Instead of having lunch in the city of Chihuahua, we bypassed it around supper time, eating and sleeping at Hidalgo del Parral. Driving that afternoon with some time allotted to collect various xerophytic odds and ends, such as *Ibervillea* species (a tuberous relative of the cucumber), *Zephyranthes longifolia*, and most importantly (for me) *Manfreda brunnea*. This last plant is an attractive species with pretty spotted leaves, mildly fragrant flowers in olive or brown, and large well-developed bulbs. Since *Manfreda* has been successfully hybridized with several *Polianthes*, we no longer ignore their potential as good breeders.

Sunday morning we entered the state of Durango, stopping only long enough to eat breakfast in a small town, where we had a tug-of-war over our food with the myriads of flies. We won, but we got a lot of exercise. Once in Durango, the plant life became vastly more interesting. Here, our collecting began in earnest, with more frequent stops. About one hundred miles south of Hidalgo del Parral, we spotted our first *Milla biflora* in flower. These always serve as good indicator plants for bulbs in general. We found an especially fine place to stop, with many *Milla*, *Anthericum* with showy white flowers, and *Ipomoeas*, and *Allium* species. Dylan at this time was attired in his basic short shorts, but an encounter with a singing little yard-long rattlesnake greatly influenced a sudden urge to wear long pants! We decided the snake was a "she" as she rattled in a very high pitched buzz, and being a lady, made no effort to show aggression. She preferred to hide under a sprawling vine in the short grass, and when pushed at with a tool, made no attempt to strike. We decided to let her be, and she slithered off under a barbed wire fence, all the time holding her tail upward and shrilly "buzzing" her warning. I could not help but admire and respect that snake. I wish they were all so well-mannered. Always my encounters with various venomous snakes in Mexico is that they wish to be left alone and will make a hasty retreat, given the chance. This includes various vipers, rattlers, and coral snakes.

We still had more collecting to do that afternoon before driving on to Durango City where we planned to have dinner and spend the night. There



Figure 2. Dr. Howard with *Manfreda brunnea* in flower; State of Chihuahua. Jane Kersey photo.

was another *Manfreda* species with rhizomatous roots (stolons), an aquatic *Allium* species, and *Sprekelia* to be collected before entering the city. We had hoped to find *Hymenocallis durangoensis* from this approach into Durango, but found none. I am afraid that it is nearly extinct, though once plentiful, since its habitat has been put to the plow. Those of us having this species in our collections are most fortunate, and I urge everyone to share it, as this may well be the only way it will survive.

When we got to Durango City I realized we still had a few hours of daylight left. We decided to drive westward into the mountains to see if we could find the rare *Polianthes nelsonii*, and other odds and ends. We found good colonies of *Prochnyanthes mexicana* on ledges above the highway. These are allied to tuberose and *Manfreda*, but have scapes up to seven feet high with olive green bells, often flushed purplish. The effect is somewhat like a small yucca, but more wiry. Bulbs are large and well-developed and the foliage is broad, dark green, and in a rosette, somewhat like a *Crinum*. They are more interesting than showy, but beautifully graceful in a subdued way. We detected no fragrance, but there was a bit of scent to them, though undefinably herbal. These too are said to hybridize with *Polianthes* and *Manfreda*, so there is a chance they may play an important part in the hybridizing of this group. The sun was setting and it would soon be dark, but we managed to find a few scattered bulbs of *P. nelsonii*, plus a few *Calochortus* with nodding purple and gold bells. By then it was time to drive back to the City of Durango as darkness loomed. One can't find plants in the dark.

Monday morning we left Durango and returned to the mountains westward that lead to Mazatlan, where we collected a good deal of *Polianthes nelsonii*. The flowers of these are creamy-white, flushed purplish, and with an odd fragrance. Foliage is erect and narrow. It's rather rare, so we felt we had done well to dig a total of about forty or so. We were relieved to know that there are still plenty of them left in the area where they are endemic, if they can survive the livestock. We also dug a pretty little *Nemastylis* species that grew with them, and these had fairly large flowers in shades of blue to white. We also dug a few more *Prochnyanthes* and stopped to photograph a particularly fine colony, observing that there was a bit of variation in the pendant bells's pigmentation. Olive-green is the basic color, but a few were a lively olive-yellow, some were decidedly purplish, or bluish, and a few were on the brown side, with a bit of wine blush. What a pity they are almost unknown to horticulture! They would make fine accent plants in a background.

We stopped in El Salto, a lumber town, high in a mountain valley to look at a clump of cultivated tropical *Hymenocallis* in bloom. They seemed content, but were clearly out of their sphere in that cooler subalpine cli-

mate. I managed to talk the lady of the house out of a few bulbs, although her husband initially had said no. I paid for them of course, but it was hardly a dent in a dollar. After all, I had to maintain my image as the last of the big-time spenders.

Leaving El Salto (which is not a pretty place, having no paving, muddy streets, and being a lumber town with only wooden buildings) caused us no sighs of lament. We could not even find a decent restaurant to invite us to pause. The "eats" for that day were strictly *ad lib*. But the flora at that elevation (ca. 7000 feet) was beautiful. I had trouble restraining Dylan (which was always a challenge), as he discovered various species of tuberous rooted *Geraniums*. I too was busy with collecting one of the most gorgeous tuberous rooted *Commelina* species with vibrant electric blue flowers. The plants were only about 8" tall, and had flowers about the size of a quarter that were exceptionally showy. When pressed and dried, the flowers retain their azure blue pigmentation. I doubted that they would grow well for me at my much lower elevation in San Antonio, but collected a few anyway. Needless to say, Dylan was like a diabetic child in a candy store. I helped him dig some of those tuberous *Geraniums*, and had to agree they were very fine.

The rest of the afternoon was scenic as we drove through many miles of pines, and later hit the swarm of mountains before dropping in elevation as we approached the Pacific coast. But no bulbs. Eventually we began the very long drive through the mountains of western Durango that merge into more tropical Sinaloa. The horizon at this point is a succession of endless peaks that blur into the distance. We were alert for the ultrarare *Hymenocallis woelfleana*, but spotted only a few, which we left alone. We found a few *Tigridia pavonia* (in leaf only) and an aroid that reminded me of an *Arisaema*, though it is probably a species of *Xanthosoma*. A delightful find was a beautiful *Chusquea* species, a bamboo with very fine foliage arranged in whorls along slender, arching canes.

Rather than drive into Mazatlan and fight the evening traffic, we stopped at a little mountain hotel (which we had tried previously and liked) for supper and lodging. The German owner was not there this time, but we relaxed and had a good time anyway, eating German food cooked by Mexicans.

The next morning found us in Mazatlan, where we found (and dug) a few *Crinum* growing in what once was a trailer park. They once had been plentiful, but were now being bulldozed. This is the hybrid we have dubbed "Empress of Mexico." We also dug a few of the red-leaved form of *Crinum asiaticum*. This is fairly common in Mazatlan, and is planted in the medians dividing the streets, and in parks, landscaping, etc.

The trip southward from Mazatlan was uneventful as far as plant

collections were concerned, since there were many miles to cover before we would find our next *Polianthes* species later in the afternoon. We did collect at a "micaroonda" long enough to obtain a nice group of *Bessera elegans*, most of which were about through flowering. For the uninitiated, microondas are towers built by the Mexican government on high hills and mountains to relay television to the more remote areas. The roads are well-kept, but somewhat primitive, and cut through wilder country than do the highways. Sometimes this gives us a truer concept of flora of the country. In the past, I have found several new species, and many of the rarer ones on such roads. This road was no exception. There too, we found a fine colony of *Hymenocallis nayaritiana* which was setting a good crop of seed. This was a bonus for us, as we wanted to distribute this species to collectors in other countries.

In northern Nayarit we came upon our second *Polianthes* species, which we tentatively identified as *P. palustris*. Unfortunately, the key to the species of *Polianthes* by J. N. Rose, published in the early 1900s, is ambiguous, and we were never quite sure which species we were confronting. Rose frequently omitted important details. At any rate, this second species was quite attractive, and casually looked more like *P. tuberosa* than most of the other species we were to find. Flowers had a buttery fragrance, white-flushed pink, on tall scapes, the foliage was narrow, bright green, and erect, and the bulbs were inclined to grow in clumps. They seemed still to be found in fairly large colonies and are not yet endangered. Growing nearby were colonies of *Cypella rosei*, and a smallish version of *Milla biflora*. We endured several small rain showers as we dug, so that we were soaked by the time we had finished our collecting in this spot. Mercifully, the rains did tend to reduce attacks by mosquitos, which would have eaten us alive had the sun been shining. The rains stayed with us as we drove toward San Blas, where we were to spend the night. Indeed, the last part of the side-trip to San Blas was mostly in a torrential tropical rainstorm, making driving in the dark quite hazardous. We arrived safely, and suddenly the precipitation ceased.

The next morning (Wednesday, the 1st of August) we drove into the mangrove swamps just outside of San Blas to collect *Crinum strictum*. They are semi-aquatic to aquatic, and plentiful along the unpaved roadside. Mosquitos are plentiful too. Dean Wm. Herbert considered this species to be intermediate between *C. americanum* and *C. loddigesianum*, and this seems a fair assumption. Casually, it appears nearer to *C. americanum*, but with longer tepal-tubes. Flowers lack the purplish tinges to the petal reverses, and the reflexing floral character of *C. loddigesianum*. Thus far, my only experiences in collecting *C. strictum* have been on the Pacific coast



Figure 3. *Polianthes* cf. *palustris*, State of Nayarit. Jane Kersey photo.

of Mexico, while *C. loddigesianum* seems to be confined to the Mexican Gulf Coast. For the moment, the two species appear to be geographically isolated from one another.

As we drove back to the paved road leading out of San Blas, we were stopped by a Mexican Army roadblock. The soldiers were armed, and searched our belongings, our persons, and our vehicle. No explanation was given. They certainly could not have cared less about our plants. This has happened to me before, so I no longer am concerned about it. It is just one of those things that happen when you get off the beaten tourist paths. Presumably, they are concerned with smuggling operations that may occur along the coast. I suspect that drugs and guns are among their top priorities. After a few minutes they let us proceed. We then drove on towards Mexico Hwy. 15 and the City of Tepic, capital of the state of Nayarit, where we would stop for lunch. We collected a *Manfreda* species in a large colony west of the city, and a few *Tigridia mexicana* var. *passiflora*. The latter had completed flowering and were starting to set seed. The *Manfreda* were still mostly in the bud stages. We saw few of the unusual violet-colored *Bessera* in this area. Apparently they had finished flowering.

Early that afternoon, we took another side trip north of Mexico 15,

to Microonda Ceboruco. First we had to pass through a picturesque little town that seemed set more than a century back in time. The road away from the town to the microonda was paved with stones and led upward to a mountain top where the microonda was perched. About 4/5ths of the way up this road we began seeing *Hymenocallis* in flower, which I hastily proclaimed to be *H. howardii*. Closer examination proved that my first impression was wrong. Indeed, these were the rare *H. phalangidis* that Jim Bauml and I had discovered in Nayarit in 1976. It is an attractive, dainty plant, with narrow bluish-green, daffodil-like foliage growing from a rather small, deep-seated bulb. The flowers are delicately spidery, in smallish umbels, and have a light but pleasing fragrance. We only dug a few, as they grew on steep slopes in the shaded hardwood forest, and the colonies were widely and thinly scattered. They seemed not to be inclined to form clumps as do many species of this genus. Since they were in full bloom, we were unable to collect any ripe seed. In this same area grew tuberous-rooted *Begonia*, and a *Manfreda* with long, strap-shaped leaves. We then drove up to the microonda, entering a wonderland of lava beds which surrounded it. The appearance was that of a moonscape. Obviously there had been some violent volcanic activity many centuries ago. The effect was eerily breathtaking.

We returned to the main highway (Mex. 15) and continued westward, as the afternoon was on the wane. At the state-line where Nayarit borders Jalisco, we came upon an *Oxalis* species, an old favorite of mine which I have collected in other years. This particular one is noteworthy in being one of the largest of the bulbous *Oxalis*, with one or two very large, ternate leaves up to 6 inches wide, though most of them are only half that large. The broad leaflets are often attractively banded purple, and the flowers are also quite large and in shades of purple. Unquestionably, it is one of the finest of all Mexican *Oxalis*, as the flowers are the largest of this genus in Mexico, often over an inch in diameter. Unfortunately, they flower in early summer, as the leaves begin to emerge, and then they continue leafing out for the remainder of the growing season. Thus they have a much shorter blooming season than do most of the other Mexican species. The bulbs are also quite large, in keeping with the proportions of leaf and flower, and have a peculiar velvety texture to the scales.

We collected a number of this species, then proceeded onward toward Magdalena, Jalisco, as it was supper-time and the sun was starting to set, not to mention the fact that we were getting tired. Magdalena is a bit more than an hour's drive from Guadalajara, and definitely not a place for tourists to spend the night, though a great place for folks like us who want to avoid the rushing frenzy of Guadalajara traffic. Anyway, there are

several interesting bulbous plants that grow around Magdalena, not the least of which is *Polianthes pringlei*, *Hymenocallis howardii*, and an *Allium* with pinkish flowers on 18" scapes.

Since the main objective of this trip was to collect *Polianthes*, we made a point to dig some bulbs of *P. pringlei*, as it has flowers individually larger than most, is fragrant, and white. The scent is pleasing, somewhat reminiscent of honey-dew melons. The flowers have segments a bit longer and more narrow than most of the others species, and are zygomorphic. Foliage is nearly erect and also more narrow than the other species. I have found them on sloping hills and in dampish meadows, in clay and gravel, so I am not exactly certain what their soil preferences might be. They do need full sun and adequate moisture in any case.

We neared Guadalajara by mid-morning, stopping once to collect from a fine colony of *Prochnyanthes mexicana* in flower along the roadside. These were typically olive-brown colored with olive-yellow interiors, loosely paired in long spikes nearly six feet high. Although closely related to *Polianthes*, *Prochnyanthes* are large plants with large bulbs and foliage, rivaling the largest Manfredas in size. Space limitations restrict the number of bulbs we can collect, so we never collect more than we wish to transport and grow. This is just as well, as they are fairly rare anyway.

Prochnyanthes is a little-known genus, and nearly unknown in modern horticulture. They are widespread in central Mexico, but nowhere common. Some may object to them because the plants are so large, and the scapes so tall, as they can reach six feet or so in height. Or perhaps it is because foliage is rather large and crinum-like, but perhaps too, because the flowers are often rather a dull coloring of green, olive, and brown. Occasionally they are tinged purplish or more rarely reddish, and then they are more colorful. In any event, the effect is always subtle and graceful. They are plants suited for the background to be used as accents. The flowers remind one of Fritillarias, in that they are bell-shaped and pendant. But they are first cousins to the garden tuberose, and are said to hybridize with them.

We approached Guadalajara shortly before noon, and decided to bypass the city and head down Mexico 80 towards the Pacific coast. Already we were at least a day and a half behind our projected schedule and we had to make up for lost time if we were to be successful in collecting all the plants we sought. Though we spoke of this trip as a "vacation," clearly it was as much a determined obsession as anything else. I had made this trip twice before so I knew that we did not bite off more than we could chew. We simply were not applying the necessary self-discipline needed to cover the miles in the given hours we had to drive and collect. Up till now,

Dylan's interest was much wider and deeper than we had imagined, and he was full of wonder at everything he saw. He wanted to dwell at each place longer, walk further, and study everything as much as possible. I, on the other hand, was placed in the position of hurrying him back into the car so we could get on with our goals. It was obvious that something had to give, or the rest of the trip would be a failure.

Meanwhile, the afternoon was good for collecting. Ahead were two more *Polianthes* species, and another *Calochortus*, plus the usual odds and ends. *P. geminiflora* (syn. *Bravoa geminiflora*) is the commonest species of the genus, and it grows in Jalisco, as well as many other states in central and southwestern Mexico. Here in the mountains north of Autlan, the form is an exquisite coral-pink, with just a touch of purplish at the segment tips. The usual forms are more of an orange-red. We really had to work at searching for them, as they were not in flower, having apparently just finished a week or so earlier. We finally located the colony, and found them in leaf and in fruit. Though not fully distinct enough to merit species distinction, I do feel it might be worthy of sub-species level, or at least of varietal distinction. Growing with these *Polianthes* was a pretty *Calochortus* with pendant plum-purple bells edged in golden-yellow. These were reminiscent of the ones we had found in Durango several days earlier, but the purple was duller and the yellow was harsher. The flowers had that same haunting fragrance of lemon-custard. (Dylan said they smelled like Freesias, and I was later to verify this. Thus, it appears that Freesias too smell of lemon custard.)

We continued driving toward the city of Autlan, and would soon encounter our fifth species of *Polianthes*. This one is closely related to *P. geminiflora*, and has similar flowers. But there the similarity ends. The new plant is a woodland plant, and a shade-lover. Foliage is quite distinct, being unspotted, rather broad and short, flat, light green, and wavy-edged. Bulbs are larger than *P. geminiflora* and have a heavier, more fibrous coating. Usually, the scapes are noticeably taller than the common species, but we did not find this to be the case this time for some strange reason. In other trips, the height was so noticeable that we eventually nick-named it "Gemi-giant." This time, the scapes were not so "giant," but there was no mistaking this distinctive species. Its range is both north and south of Autlan, almost to La Huerta. We stopped and dug a number of this species, which in my original collection notes is #65-42. (but is #84-26 for this collection), as I usually give new species the original number for future reference in my system. Subsequent collections are recorded as "synonym" numbers. That way, I don't encumber the species with a long litany of numbers to confuse the recollection. Naturally, all subsequent collections,

numbers, dates, etc., are carefully recorded in my notes in order to avoid mistakes. We first collected "Gemi-giant" twenty years ago, and oddly, it still is an unpublished species to my knowledge. Certainly, it is a fine garden plant, both showy and easy to culture.

We drove southward from Autlan, stopping long enough to eat supper in La Huerta, late in the afternoon.

Leaving La Huerta, we drove to the coast, arriving at our destination shortly after sundown. We ate supper and spent the night in Barra de Navidad. The next morning we drove down the coast to Manzanillo, in the state of Colima. We did not tarry, as we had many miles of driving to do that day, and at least one important collection to make. It was at this time that my mental computer forced me to make an important decision. We were now nearly two days behind schedule, so I decided to pass up driving to the City of Colima and beyond, where *P. howardii* grows. This was not much of a sacrifice, as we still had plenty of them growing in San Antonio from our earlier collections of 1972 and 1976. Instead of driving back to Guadalajara, we would continue our drive down the coastal highway to Playa Azul, Michoacan. In that way we would pick up at least one full day (maybe more) of our projected trip. But not before we drove a few miles toward Colima City to collect some interesting bulb material in a canyon with many limestone outcroppings. Our objective was to collect the fabulous, giant, purple *Bessera* that is endemic to that area. There too grows the lovely yellow-flowered irid, *Nemastylis convoluta*, and some fine forms of *Hymenocallis proterantha*. We did find *Bessera* in flower, and got what we wanted. We also collected a few *Hymenocallis*, but found no *Nemastylis*. They are there, and they are quite rare, but we did not have anymore time to dedicate to their capture. Instead, we drove back down the road toward the coast and resumed our journey toward Playa Azul. It was a long trip, with little time to stop and collect anything. The trip was more scenic than I had imagined, and I would have loved to have taken more time to snoop about for plants, but now we were desperately trying to make up for lost time. Since the road was fairly new, there was very little traffic. Towns were very few, small, and far between. We stopped to take pictures of *Crinum strictum* growing near a bridge. The road was good and fast, but it would have been a dreadful place for a car to break-down. This did not happen, fortunately, and we finally arrived at Playa Azul after nightfall. It was late, but luckily the hotel restaurant had not yet closed.

After breakfast the next morning, we left Playa Azul behind and drove towards Arteaga on Mexico 37. I had collected a variety of interesting bulbs north of Arteaga in 1967 and 1976, but not this time. We looked for



Figure 4. *Crinum strictum* along the road to Playa Azul. Jane Kersey photo.

Hymenocallis and a pretty little glaucous-leaved *Sprekelia* with pinkish-red flowers, but could find neither. We dug a few bulbs of *Bessera elegans* with brilliant scarlet flowers. *Hymenocallis glauca* grew there too, but we did not need any, so we left them alone.

Shortly before noon, we came upon the area where the very rare *Dandya hannibalii* grows. This was to be an especially important collection for us, so we spent considerable time combing the hills where I knew they grew. We had almost given up when Dylan finally found one. Then we found another, and another, and so on. Eventually we had enough. They are endemic to this area, and not at all common, but surely there must be other nearby locations for them as there is a lot of similar countryside in all that vast wilderness. If one but had the time to spend a few days in such places. . . .

Dandya hannibalii is a lovely member of the *Milla-Bessera* clan, with starry, violet, up-facing flowers, somewhat like an *Allium* in appearance. The petals recurve slightly, and the stamens thrust upward from the segments. The stamens are connate, microscopically united into a tiny crown at their base. These do well in cultivation in full sun and ordinary garden conditions, but they are not winter-hardy, as they come from the "tierra caliente" area, which has hot summers and hot winters. Though rare, this *Dandya* is easy to grow and flower, and sets seed readily. Seedlings take 3-4 years to flower.

Later that afternoon, we passed through the town of Zamorra, Michoacan, pausing long enough to see if a small colony of *Crinum cruentum*, which had become a garden escape, was still alive and well. These had once escaped into irrigation ditches and established themselves, but were being persecuted as weeds and chopped-out. They are still there, but the population is only a shadow of its former self.

It was almost sundown when we passed through Uruapan and drove onward toward Patzcuaro where we would spend the night. There was still enough daylight to dig a few bulbs of *Hymenocallis leavenworthii*, which were flowering along the roadside. This is endemic to Michoacan, and is another one of the rarer *Hymenocallis* species of Mexico. We arrived at Patzcuaro after sunset, checked into a fairly decent hotel, and readied ourselves for supper. A TV set in the hotel lobby was showing the results of the Los Angeles Olympics. Were I not on a botanical expedition, I'm sure I would have been watching the Olympics at home. Supper was good, as we ate those famous, delicate "pescado blanco" (white fish) which come from Lake Patzcuaro. They are fried in a delicate egg batter, and eaten with a squeezing of lime juice; delicious!

After a hearty breakfast the next morning, we commenced our ad-

venture once more. Once back on Mexico 15, we were heading eastward toward Morelia and Toluca, where we would spend the night. It's a long mountainous drive, but scenic and the temperature is always spring-like. At mid-morning, somewhere between Quiroga and Morelia, we stopped to collect some good orange-red flowered specimens of *Polianthes geminiflora*. These colors are definitely more orange than the ones closer to Mexico City, which run to coral and rosy-pink. One colony had a number of extra-large forms, nearly twice the size of the type, suggesting that there may be polyploids in some populations. A few miles west of Morelia, we stopped to collect a few *Manfreda* flowering along the roadside. These had attractive greenish-yellow flowers, considerably more colorful than is normal for this group. It is a recently named species, *M. longibracteata*, endemic to this region. By mid-afternoon we were nearing Zitacuaro, and stopped to collect *Tigridia violacea* growing in a depression in heavy soil near the roadside. They had finished flowering and were beginning to set seed. It is one of the early summer-blooming *Tigridia* that sends up scapes with the first rains and then leafs out the remainder of the summer. We also collected several tuberous *Begonia* species during the course of the day, but we could not identify any of them. Mexico is rich in many species of *Begonia*.

We made many stops the remainder of the afternoon, but could not find any bulbs of consequence. The weather was misty and cold, and much of the land that is not mountainous is under cultivation. We arrived at Toluca before sunset, and decided to drive on to Ixtapan de la Sal to spend the night. Ixtapan is a pretty little town famous for its thermal baths. There are many tourist facilities but it never is crowded. The food served in our hotel was very bland and boring. I've eaten there many times before and have never been served anything to do cartwheels over. I must make it a point in the future to find a place with better "vittles." I've eaten better in hospitals.

The next morning (Monday, August 6) we left Ixtapan and headed southward towards the state of Guerrero where a different group of bulbous plants awaited us, as well as a welcome change of scenery and climate. Nearing Taxco, we stopped to dig tubers of the fantastic *Begonia* whose single, round leaf, up to 13" across, grows flat up against the vertical road cuts. Later we stopped to dig *Milla magnifica* a few miles from Taxco. These were still in the bud stage and would flower about two weeks later. This species is particularly attractive in that it is larger than the other species, with more flowers per umbel, and is easier to grow in cultivation.

We lunched in Taxco, and took a little time to shop around. Taxco is simply not a place to hurry. Its atmosphere harkens back to early colonial

Spain, and it beckons the traveler to slow down. But we could only do so for a moment, as we had more miles to cover that afternoon. We left Taxco and drove toward Iguala, and Mexico 95, which is the highway to Acapulco. We were now back on the beaten track, but still in an area full of interesting plant life. Our next goal was to find *Dandya thadhowardii* which is endemic to this part of Guerrero. Though not showy, the flowers are quite interesting, as the petals reflex like "shooting stars" (*Dodecatheon*), and the filaments curve inward toward the center to form a little "bird cage" enclosing the small green ovary. These dainty cormous plants are closely allied to *Bessera*, and their flower form is just as outrageous. We also spotted an interesting *Milla* growing on a rocky ledge above the highway, but these were out of reach and we had to give up on them. We drove further up this road and stumbled upon a colony of *Hymenocallis guerreroense*. What luck! I had not been able to relocate this rare species since 1973, although I have made several attempts in the interval. This is another one of those super-rare species that seems to be endemic to a very small area of Guerrero. They grew atop very rocky ledges and under shrubs and the digging was difficult, since the bulbs were deeply situated. With them grew the lovely *Sessilanthera latifolia* var. *heliantha*, a bulbous irid related to *Tigridia* and *Nemastylis*. This variety is quite common throughout this part of Guerrero, and the little yellow flowers greet each summer morning with cheerful, sunny expressions. In a few hours they are gone, but the process is repeated again for weeks. Luckily, they are easy to grow, and seedlings mature quickly. Clearly, *Sessilanthera* are plants that belong in cultivation.

We were running out of daylight again, so we pressed onward to Chilpancingo, the state capital, for nourishment and lodging. Though a fair-sized city, it has little to offer the tourist, and the more time I spend there, the less I like it. We walked through the downtown city park the next morning, which was full of little booths selling Marxist propaganda, among other things.

After stopping long enough at a bank to exchange more dollars into pesos, we hit the road westward for a side-trip to Chilapa. We collected more *Sessilanthera*, but the most exciting find was a beautiful yellow flowered morning-glory, growing from a tuberous root. Dylan had mentioned that a yellow species was known from Baja California, but this one in Guerrero took him by surprise. We looked for *Polianthes geminiflora*, but could not find any this time. Nor could we find the unusual *Milla biflora* forms with longer filaments. We did dig a few bulbs of *Hymenocallis glauca* as a token collection. With this species, it is very difficult to dig them intact as the basal plates all too readily separate from the deeply situated bulbs.

We found *Tigridia pavonia* flowering on a slope near the highway, in the more common scarlet version. We stopped to admire them, but did not disturb them. We ate lunch at Chilapa, after fruitlessly driving around the city in search of Indian masks. I had stumbled on them once before, in 1972, but not this time. Guerrero is known for its many unusual masks carved from wood of native trees, and some are considered collectors items.

It was still early in the afternoon as we headed back to Chilpancingo. It was then that Dylan and I decided to drive on down to Acahuizotla and see if we could find any bulbs of *Petronymphe decora*, an exceedingly rare little relative of *Bessera* and *Milla*, and nearly extinct. Flowers are greenish-yellow and pendant, with long slender pedicles in the umbel, the whole of which resembles an exploding sky-rocket. Once plentiful, they have been collected to near extinction by certain Dutch firms. Not at all showy, they are none-the-less interesting because of their form and muted colors. In less than two hours we were there and the search began. I managed to find a few on the rock walls, but they were inaccessible. Eventually, we managed to dig a half dozen very small bulbs, but what few of the larger ones we saw are still there, undisturbed. Luckily, it thrives on the faces of cliffs, and there the species must be making its last stand. What a shame. They were once plentiful. Most rare species are threatened by overgrazing, cultivation, and destruction of habitat. This is not the case with *Petronymphe*, which has been collected to extinction by greedy, mindless bulb dealers. The habitat is still intact, and neither animals, nor the Indians disturb *Petronymphe*. Indeed, the village of Acahuizotla is not even on a paved road. The country is wild and full of many interesting plants, such as orchids, bromeliads, *Achimenes* and other gesneriads, *Hymenocallis*, *Dioscoreas*, *Bomarea*, irids, *Bessera*, etc. When I first encountered *Petronymphe* in 1968, large clumps grew in quantity on the face of cliffs. No longer is one greeted by such a sight.

We returned to Chilpancingo. The next morning would see us finally heading homeward. We had several days to drive northward to central Mexico, and try to pick up a few more *Polianthes* species. We ate breakfast at the bus station, and that turned out to be a mistake. The food was fine, but after the station was emptied when the passengers got back on their bus, some idiots working in the kitchen decided to shoot off an entire package of firecrackers in the dining area, for our benefit of course. It was not intended for our amusement, but clearly was meant to disturb us. Dylan and Jane covered their ears, but I sat impassively, as though nothing had happened. I would not give them the satisfaction of letting them know how really angry I was and how much my ears ached. This was an indignity that one learns to bear with stoicism. But I still seethe inwardly when I

recall the incident. Little wonder that memories of Chilpancingo rank at the bottom of my list. I have recollections from earlier trips there too, and none of them are good. In years long passed, this part of Mexico was always a problem for the Mexican government. I think it still is.

After leaving Chilpancingo, we took a short side-trip west on a paved road to collect a few more *Sessilanthera*, which are abundant. Growing with them we found the rare miniature *Sprekelia* species that we had discovered in earlier years. These seem to be in good supply, as the countryside is still in fairly good shape. We then retraced our steps to the main highway, Mexico 95, where we collected a few more mini-*Sprekelia* growing on rocky hillsides in scenic Zopilote canyon, along with an unusually pretty little *Commelina* with pink flowers blooming in a rosette of purple dotted leaves. The plants resembled *Echeveria*, but had small tubers for roots. The little flowers were in small bunches, like African violets.

Arriving at Iguala early in the afternoon, we took another side-trip on Mexico 51, towards Teloloapan to collect *Sessilanthera latifolia* var. *latifolia*. This is a white-flowered form, and is more robust than the yellow-flowered form, and less common. It is easy to grow, and a wonderful garden plant. After this collection, we drove back to Iguala, then retraced our trail to Taxco. This time we did not stop, but pushed forward, as we wanted to return to Toluca, where we would spend the night. It was now Thursday, and we wanted to be home in San Antonio by Monday afternoon. Our "vacation" was now on the wane and the rest of the afternoon was dedicated to driving. We had already exposed ourselves to this route a few days earlier and there was little reason to tarry. As usual, we arrived at our destination shortly after sunset.

After a fine breakfast the next morning, we were on the road once more, heading towards Queretaro on Mexico 55. By noon, we were nearly to San Juan del Rio, and we stopped just long enough to collect *Polianthes geminiflora* and a lovely yellow-flowered *Calochortus*. The *Polianthes* here are mostly in shades of coral-pink and rose-pink; very lovely. The *Calochortus* were strongly scented of *Freesia* (or lemon-custard ice-cream, if you will) and smelled good enough to eat for dessert. We then drove into San Juan del Rio, where we lunched at a nice continental-style restaurant; the food was excellent.

By late afternoon we reached the city of Guanajuato, and for a change had time to relax and look around. The hotel was one of the best we had stayed in on the trip, and the food was again excellent. But we elected to dine in the market place and "get-down" on real Antojitos (native Mexican food).

We breakfasted in the hotel the next morning on a smorgasbord of

breakfast "goodies" and it was worthwhile. Then back on the road again.

It was Friday, August 8th as we drove from Guanajuato, and past Leon. Soon we would be looking for yet another *Polianthes* species, affectionately known as the "little stinker." These grow about 15 miles west of Leon in rolling plateau country, and very much resemble tuberose on a smaller scale. My original collection number for this species is 65-59, but our 1984 collection is numbered 84-46. Flowers are basically white in color, but there is considerable variation in color, and some are flushed pinkish or even reddish, and a few are cream-colored instead of white. Their shape also differs to a surprising degree. All are scented, but there is variation in this too, as some are sweetly scented and some have the rank smell of rancid butter. One is never certain of getting a whiff of something pleasant or something unpleasant when sticking a nose into a group of these and inhaling. This species does fairly well in cultivation, and it has been successfully hybridized with *P. tuberosa* by Luther Bundrant. The hybrids retain the smaller size and appearance of "little stinker" but are delicate and show some of the characters of tuberose, especially in the floral form.

The remainder of the afternoon was spent driving and looking. We arrived at Aguascalientes reasonably early in the afternoon (for a change) and decided to drive eastward on the road to San Luis Potosi and see if we could collect two more known *Polianthes* species. Unfortunately, we should have driven east instead of west, but our notes were unclear on this point. So we spent the afternoon on a wild goose chase probing for plants that were not there. We did find a nice population of a yellow *Calochortus* species on the hillsides and scattered colonies of *Habranthus concolor*. One of the most beautiful orchids of the whole trip, a large flowered, green and white *Habenaria*, grew here also. We returned to Aguascalientes by sundown for lodging and a much appreciated supper.

The next morning we drove eastward from Aguascalientes, and this time we did find *Polianthes* species. We found several colonies of an unidentified species that I had collected in 1976 under the number 76-158. The new number assigned this trip is 84-51. Another of the fragrant kind, with white flowers flushed pink or red, we don't know for sure if this is a new species or simply an old species described by J. N. Rose that we can't identify. Our plant comes closest to *P. durangensis* in Rose's monograph, but the anthers are not extruded enough to agree with his plant. Nonetheless, this species is quite attractive and the colors are variable enough to make it quite interesting. The base color is white, but most are tinged in varying shades of pink, particularly as the flowers age. But the surprise is that a few are actually a deep rose-red!

We sought *P. graminifolia*, which we found growing with #76-158 in 1976, but could not find any, although I recall them being fairly plentiful then. Finally we did find a few plants and dug one, which Dylan kept. *P. graminifolia* seems to be rare, but is known from the states of Aguascalientes, Jalisco, and Zacatecas. At first glance, it looks quite a bit like *P. geminiflora*, but the flowers are more flared, and the foliage is minutely pubescent. We also collected a few *Manfreda* species, a few *Prochnyanthes*, and some *Calochortus* before returning to Aguascalientes. We continued through Aguascalientes towards San Luis Potosi where we ate a late lunch. We made another side trip east of San Luis Potosi on the road to Rio Verde for some last minute collecting. The road climbs from San Luis to a much higher elevation in the next twenty miles and ultimately took us to Valle de las Fantasma, where the strange rock outcroppings take on a ghost-like atmosphere, especially in the evening. Here we collected *Tigridia vanhouttei*, a few *Echeveria*, and some *Milla biflora*. It is interesting to note that a few miles below there is an interesting night-flowering *Milla* species, still undescribed, but at this higher elevation it is replaced by *Milla biflora*. Just where the cut-off point is is anyone's guess, but they do not seem to overlap.

After retracing our steps to San Luis Potosi, we drove northward to Matehuala, where we'd spend the night, stopping to collect an interesting desert *Echeveria* and a few *Allium* along the way.

The next morning we cleaned our plants, and what a mess that was. Eventually we had them clean enough for inspection when we hit the Texas border in Laredo. Good thing too, as the USDA inspector was very thorough and not to be hurried. After that, it was homeward bound, and we arrived early in the afternoon, tired, but feeling that our trip had been successful. No question that the trip was an adventure, and one that we will continue again in 1985. We plan then to collect the *Polianthes* of southern Mexico (Oaxaca and Chiapas) plus some of the other rare and exciting bulb life of that region.



Figure 5. *Milla biflora*. Jane Kersey photo.

BOOK REVIEW

THE FACTS ON FILE DICTIONARY OF BOTANY.

Elizabeth Tootill, General Ed.;
Stephan Blackmore, Consultant Editor.
Fact on File Publications:
400 pgs. 1984. \$21.95.

This Dictionary deserves high praise and rightly so. It is surely one of the best and most comprehensive dictionaries ever to originate in the plant sciences. It encompasses all aspects of pure and applied botanical sciences. Clear, concise definitions are provided for botanical terms from **abaxial** to **zymase**. For some processes where more explanation is needed, a discussion of up to about 500 words is provided, e.g. cladistics, herbarium, mutation, etc.

In addition to the traditional plant disciplines, such related fields as agricultural botany, horticulture, and microbiology are covered. The Preface states that bacteria and viruses are also included because of their importance to plant pathology and plant ecology.

A unique feature of the Dictionary is the attractive line drawings, graphs, charts, and diagrams of important organic chemical compounds, e.g. amino acids. Neat, clear diagrams of such processes as the main biosynthetic pathways in plants; geological time scales and the origin and relative abundance of different plant groups; simple classification of the different types of true fruit, etc., are accurate and informative.

This is not a taxonomic Bible; species names are wisely omitted, largely because of the controversial and shifting nature of genera and species names. As compensation, higher ranks of plant groups such as divisions, classes and the more important orders and families are given. Incidentally, I was surprised that the authors did not include the Cucurbitaceae, a family of vast economic importance in the Americas, Asia, and Africa, but probably of lesser importance in Europe. This is a judgment decision, and does not detract from a much needed and valuable contribution to botanical scholarship represented by this Dictionary.

All this information is served up for the price of \$21.95, truly a remarkable value in these days of inflated book prices.

Thomas W. Whitaker.

RECENT LITERATURE OF INTEREST TO READERS

(Please advise the Editor of interesting literature you encounter)

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